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Design and Development of Disc Shape Flying Saucer

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Abstract- This paper describes about the design and development of disc shape "Flying Saucer". In general case, when an element who captured the sensitive areas like temples, masque and public places, in that condition our soldiers won't be able to fight with them due to non-visible of elements. In the proposed solution, a Flying Saucer will definitely satisfy the needs. This has been tested and there results along with design have been specifically details in it**.**

Index Terms- Flying Saucer, Mechanism of flight..

1. INTRODUCTION

It is very hard to think about hard work. Sky has always fascinated man. Hence aerial travel has aroused great interest in man.

Right from the time Wright brothers had invented the first aeroplane; aerial travel has been on its way to progress in a sky rocketing pace. At first subsonic flight wear replace by sonic ones and at length man has even conquered sound, by making the supersonic planes. Also the bulky awkward looking planes were given a compact stylish look. Now a days the defense in any country is most important and advance development sector, that is the reason where different shape and size of different concept are been use to nullify opponent attach in multi way. In this series, the flying saucer is new which a multi uses like are small space, compatibility, spying, & it could be use in traveling also.

Before dealing with the design of flying saucer in this paper, we are enlighten to express our first step to make this paper successful, then we go through the basic knowledge of flying theory, concept of our saucer shape, mechanism, flying capability.

A disc-shaped aircraft has the potential to be a highly maneuverable remote-controlled aircraft. The aim of this paper was to design, build and test a disc-shaped aircraft that makes use of no control surfaces, and can travel in any direction, unlike conventional aircrafts which can only move in 5 directions – straight ahead, left, right, up or down. Sometimes anti social element captures the sensitive areas. In this situation our soldiers are helpless to fight with elements. Our proposed spying object will definitely help our soldiers in crucial situations. In future other can also work on this project to make more convenient and useful tool for defense requirement. We are hope for reading this paper will give you knowledge; enjoyment & how problem will be sort out.

2. SELECTION OF MECHANISM

It was a difficult task for all five of us to select the mechanism, which will give our shaft a 90-degree anticlockwise rotation. Each of us scratched our heads and let our brain pushed to limits. But after a lot of hustle &bustle and a prolonged discussion we sorted out two mechanisms, which are:

- With worm gear
- Without worm gear.

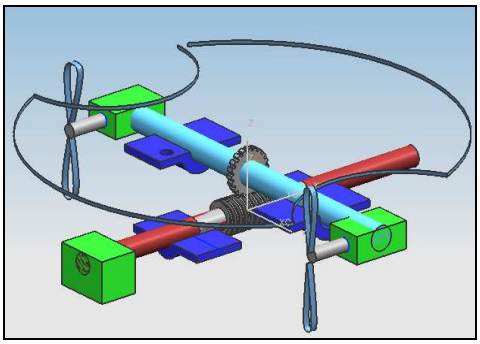

Fig.1 Schematic of Flying Saucer

It was hard to select from both the mechanism, the efficient one. Since both the mechanisms are efficient in fulfilling the purpose of rotation of shaft through 90 degree. We have to consider many factors before our final selection, which are as follows:

(1) Weight of the whole body.
(2) Thrust that will be faced by the shaft during rotation.
(3) Power that will be required to drive the mechanism item in the first level.
(4) Load acting on the mechanism.
(5) Factor of safety.
(6) Distribution n of load on the shaft

After evaluating all these factors and performing all the calculation, our conclusion was to select the mechanism on the practical performance basis, since both of them proved efficient on theoretical & calculation basis.

3. REQUIREMENT OF MECHANISM

- WORM GEAR – A worm gear with a worm wheel made out of Teflon .It should be light weight but good in strength. It also posses the specialty of transmission of motion through 90 degree.
- TRANSMISSION SHAFT – It is required for transmitting the power from D.C. motor to the worm gear.
- D.C. MOTOR – It is required for giving the rotational motion to the transmission shaft.

4. WORKING OF MECHANISM

- Here the D.C motor is situated at right angle to the engine-mounted shaft towards the nose. The rotational motion from the D.C. MOTOR is transmitted to the worm gear through the transmission shaft. On the other hand the worm gear is transmitting the rotational movement through 90 degree to the engine-mounted shaft thus facilitating its 90 degree anticlockwise rotation.
- So after going through all the hurdles, we selected the mechanism with worm gear to be employed in our project for giving the 90-degree anticlockwise rotation to the engine-mounted shaft – A worm gear with a worm wheel made out of Teflon .It should be light weight but good in strength. It also posses the specialty of transmission of motion through 90 degree.

5. WORM GEAR

The components of mechanism with worm gear are enlisted below:

5.1. *Balsa wood*

Balsa wood is basically a light weight wood with good strength. It is most popularly used in aero model designs. Most of the structures of aero model are made from balsa wood. It possesses sufficient rigidity to resist the wind velocity. Thin sheets of balsa wood are used to make fins & body of the aircrafts in aero modeling. It was used 4mm-5mm thick sheets of balsa wood.

5.2. *Shaft*

Shaft is basically a power transmission medium which can also be used to give support to the engine mountings. Steel is most popularly used as shaft in aero modeling designs. Steel shafts possess sufficient rigidity & strength to support the aircraft body. It is also used to transmit the motion from the motor to the desired equipments. It was used a 3cm diameter steel shaft which can give sufficient rigidity to the aircraft body.

5.3. *Engine*

Glow plug engine is basically employed in the aero models where they are used to generate a rotation of the order 16000-17000 rpm of the propeller. It is a light weight engine with high power. Here two 6cc glow plug engines and each one of them weight around 450gm.

6. WORM GEAR AND WORM WHEEL

The worm gear & worm wheel are basically employed to change the direction of motion by 90 degree. They can be made from many materials such as brass, steel, Teflon, plastic& nylon. Hey are also available in different sizes. Here 8cm diameter of wheel with 8cm diameter of worm gear integrated in shaft was used.

7. PROPELLER

The Propeller are the wing blades mounted on the engine shaft which are used to generate the necessary thrust required for the take off & flying. They are made from various materials such as nylon, wood & metals. The 11*6 cm propellers on both the engines were used.

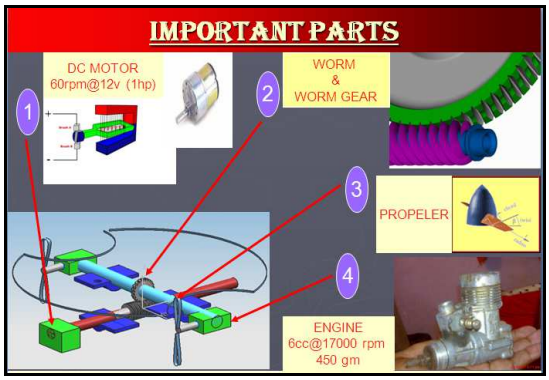

Fig 2: Saucer

Fig 3: A 6cc glow plug engines

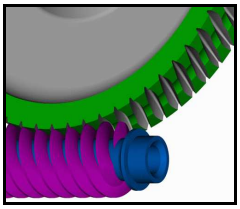

Fig 4 : A Schematics of worm gear and worm wheel

Fig 5: Propeller

Fig 6: A Picture of DC Motor

Fig 7: Schematics of Fuel Tank

Fig 8: Work Operation of building flying saucer

8. D.C. MOTOR

The D.C. motor is basically used to generate the power required for various motions of gear & shaft present in the aero model. They are generally battery operated motors. Here we were employing a 2H.P, 30rpm D.C. motor which will give sufficient power to the worm gear to facilitate the anticlockwise rotation of the engine mounted shaft.

9. BEARING

The Bearings are mainly used to give support to the transmission shaft during its motion. There are mainly two types of bearings.

(1) Roller & ball bearings.

(2) Journal bearings.

For the flying saucer brass made 0106 ball bearings with 3cm diameter are used.

10. FUEL TANK

Fuel tank is mainly used to carry the fuel necessary for driving the engines. Fuel tanks are available in many sizes according to the requirements. In this model a 500ml plastic fuel tank to supply the fuel to both the engines are used.

11. WHEEL

For the proposed Flying Saucer four roller wheels which are made of rubber to give support to the aircraft during landing & take off.

12. AERONOTICAL CALCULATION

12.1. *Stall speed calculation*

To create a vortex on the flapatron, i.e. to create turbulent flow there should be Reynolds no. more than or equal to $5x10^{-5}$

So, Rex=$5x10^{-5}$

(U x L)/υ =$5x10^{-5}$

(U x 0.4)/$1.47x10^{-5}$ =$5x10^{-5}$

[assuming kinematics viscosity, υ=$1.47x10^{-5}$]

U=18.375m/s=66.15km/hr

i.e. stall speed, V_{stall} = 66.15 km/ hr.

Thrust required for lifting

We know that

$V_{stall} = \sqrt{[(2 \times w) / (\rho_{air} \times s \times C_L)]}$

Where ρ_{air} = density of air, s= wing area, C_L =co-efficient of lift

$18.375 = \sqrt{[(2 \times 34.34) / (1.2 \times 0.502 \times C_L)]}$

C_L= 0.33

Again $C_D = C_{D,O} + \{C_L^2/(\pi \times e \times A.R)\}$

Where C_D= Co-efficient of Drag,

e= Oswald efficiency factor, A.R= aspect ratio= b^2/s, b= wing span

$C_D = 0.02 + \{0.33^2/(\pi \times 0.8 \times 2.652)\}$

C_D= 0.036

Lift/ Drag =C_L/C_D= (0.33/0.036)=9.166

Thrust required, T_R= W/[Lift/ Drag]

T_R= 34.34/[9.166] N

T_R=3.746 N.

12.2. *Ground off effect*

To avoid ground off effect, Φ<1

$\Phi = (16\ h/b)^2 / [1 + (16\ h/b)^2]$

Here, h=height of the wing from ground= 0.15 m, h/b = (0.15/1.154) = 0.13

$\Phi = (16 \times 0.13)^2/[1 + (16 \times 0.13)^2] = 0.812$

i.e. safe ground off effect.

12.3. *Thrust required curve*

Vstall	C_L	C_D	C_L/C_D	TR
15 m/s	0.507	0.058	8.6	3.97 N
18m/s	0.350	0.038	9.07	3.78 N
21 m/s	0.258	0.030	8.59	3.99 N
24 m/s	0.197	0.025	7.616	4.51 N
27 m/s	0.156	0.023	4.59	5.21 N

13. REMOTE CONTROL

There are four important parts of remote control.

- Transmitter: It sends radio waves to the receiver
- Receiver: An antenna and circuit board inside the aero model receives signals from the transmitter and activates motors inside the toy as commanded by transmitter.
- Servomotor: Servomotors can turn the flaps elevators and engine mounted.
- Power source: The power source is basically a rechargeable battery.

The transmitter sends a control signal to the receiver using radio waves which then drives motor causing a specific action to occur. The motor in a plane may adjust the flaps. The power source is typically a rechargeable battery pack.

When you press a trigger to make the plane move forward. The trigger causes a pair of electrical contacts to touch completing a circuit connected to a specific pin of an integrated circuit.

The completed circuit causes the transmitter to transmit a set sequence of electrical pulses. Each sequence contains a short group of synchronization pulses, followed by the pulse sequence. The transmitter sends bursts of radio signals that oscillates with an assigned frequency. The plane is constantly monitoring the assigned frequency for signal.

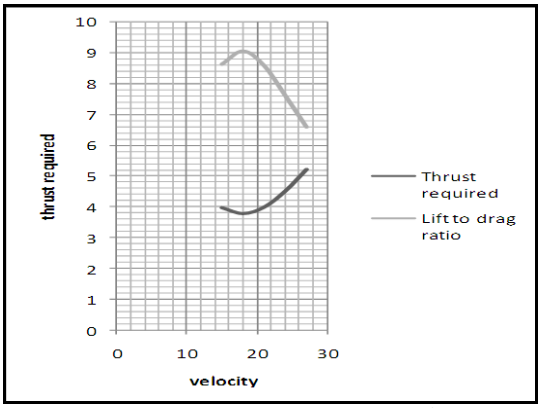

Fig 9: Relation between thrust required & angle of attack

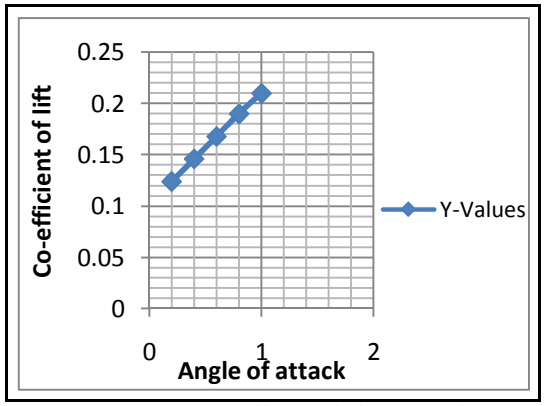

Fig 10: Relation between co-efficient of lift & angle of attack

When the receiver receives the radio bursts from the transmitter it sends a signal to a filter that blocks out any signals picked up by the antenna other than the assigned frequency. The remaining signals are converted back into an electric pulse sequence.
The remote control that is employed in our project has more than six switches. Each switch is dedicated to operate a particular servomotor.
The various switches that are dedicated to servomotors are:

- Two main switches for controlling the ailerons servomotors.
- Two switches for controlling the throttling of the engine through servomotors.
- A single switch for controlling the D.C. motor that can turn the engine mounted shafts through 90 degrees clockwise rotation.

Our remote control is rechargeable and it is very handy. It can works within the range of 1 km Bearings are mainly used to give support to the transmission shaft.

14. ASSEMBLING OF DIFFERENT PARTS

The whole structure of the 'flying saucer' is made out of balsa wood. Here the shaft is used as a support giving as well as motion transmission object. The shaft is placed laterally on the structure of balsa wood with the help of bearings. The bearings facilitate the rotational motion of the shaft on the balsa wood. Both the glow plug engines are placed laterally on the ends of the shaft with the help of wooden block support to avoid vibration the shaft during its motion. There is propeller fastened on both the engines shafts with the help of the bolts. Propellers are required to give the sufficient thrust for lifting by rotating at17000 rpm.
The worm gear and worm wheel are mounted on the middle of the shaft. The worm gear with the help of worm wheel facilitates the 90 degrees transmission of motion.

The power required for the motion of worm gear is transmitted through the D.C. motor. The D.C. motor is situated near the nose by considering the centre of gravity of the whole body. There is a shaft between D.C. motor and worm gear for transmission of power from the D.C. motor to worm gear. The fuel tank is also located near the nose for the supply of fuel to both the engines. The fuel tank has a capacity of 500ml to facilitate for 20 min. of flying. Three wheels are fastened at the base of the body, two at the front and one at the rear. The rear wheel is also steerable to give the direction of motion to the body.

15. TEST FLIGHT

At least the much-awaited day come. It's like a dream come true for all of us. It's truly soothing for our eyes to observe the final result of our hardships. Every one of us has already imagined our 'FLYING SAUCER' flying freely in our dreams.
Really it was a special day for us. From the morning itself, everybody of us was full of excitement. There was a lot of hustle and bustle from the morning. In the previous night, we decided that the flight would take place at 10 a.m. in the morning at GODHANI ground. After compiling all the necessary equipments required for the flight we headed for the ground.
After reaching the ground, we assembled all the ports of the flying discard then we fulfilled its tank by the hand pump. At first, we tested its propeller-mounted engine by running it at varying speeds with the help of different fuel supply. After words we check all the servomotors working through the remote. After conforming that everything is perfect and all right, we landed it on the ground for the actual flight.

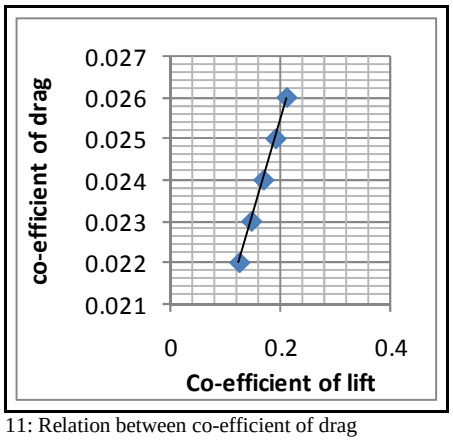

Fig 11: Relation between co-efficient of drag & co-efficient of lift

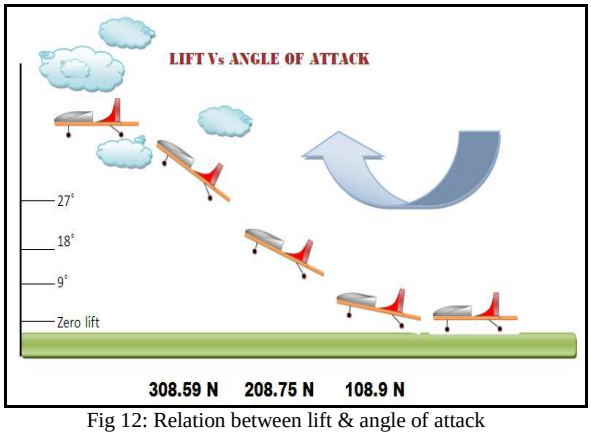

Fig 12: Relation between lift & angle of attack

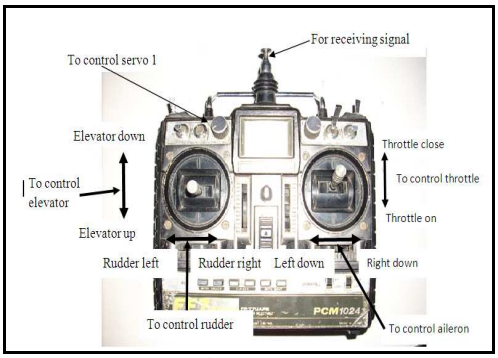

Fig 13: A Schematics of Remote Control

Fig 14 : Proposed Flying Saucer

Each one of us heart was pounding like a pump in our body. At first both the engine were started and then gradually we removed our hands from it. No sooner we removed our hands from the flying disc, it run away like a jet. Everyone of us hold our breath until it left its wheel from the ground our flying disc at last projected towards the with a dazzling speed and making a merry sound. It was really artistic on the part of the aero modeler to control and perform acrobats in the sky. The flight carried on for 20 min. but this 20 min. were the most satisfy able and remember able for all of us. The flying disc was showing its magic in the sky by performing all it's operating with perfection. After the 20 min. flight it landed on the ground as if an eagle landing to the ground for drinking water. After a tire some flight. Again we disassembled all the parts of the flying disc and headed towards our home. But this test flight of our 'flying saucer' we will never going to forget whole.

16. CONCLUSION

This paper comprehensively gives an idea to develop a disc shape Flying Saucer. The flying object has been successfully tested & obtained favorable results. It is highly desirable this concept should be applicable in Indian Army.

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Appendix A. DESIGN OF FLYING SAUCER

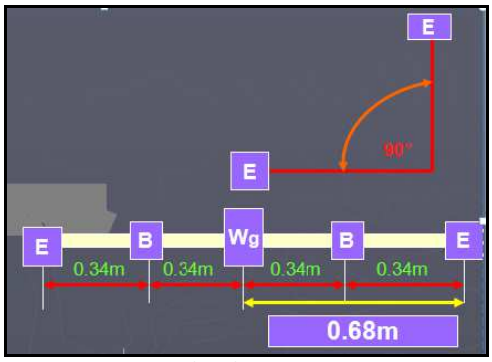

Fig A1: Schematics of shaft with worm gear

A1. Design calculation

Given	**Formula**	**Values**
P_r		2HP
Pd	1.1*2	1.64KW
N	¼ sec Revolution=2 sec	1/8*60=7.5 RPM
VR	Nw/Ng	= 30/7.5 = 4
Tw		= 6
Tg	6*4	24
α 1	6*Tw	=6*6=36˚
α 2	tan^-1√(Ng/Nw)	= 32.20
Φn		30˚
Dg	m.tg	24m mm
Vp	л.Dg.Ng/60*1000	= 9.42*10^3 m
Ft	Pd/Vp	=1.64*10^3/9.42 *10^-3 m=174.09*10^3/ m
Γ		= 0.548
FB	30.Cv.γ.b.m	
Cv		= 0.75
So		473 MPa, Material SAE 6145 Heat treated Alloy steel
b		= 2.38 л m
Fb		=473*0.75*0.548 *2.38лm^2=1453 .54m^2
	Fb =Ft	
	174.09*1000/m=1 45=3.54m^2	
m		= 4.92 = 5
Dg	Actual Values **=5*16**	**=80 mm**
Vp		**0.0471 m/s**
Ft		**34818 N**
Cv	**4.5/(4.5+Vp)**	**=0.98**
b	2.38(л*5) +6.25	**44 mm**
Fb	473*0.98*0.548* 5*44	**55.884.38 N**
Dw		**46.91mm**
Lw		**71.31mm**
Vr	л* Dw* Nw/cosλ*100	**5.46 m/min**
μ		0.082
	Tanθ= tanφn.cosλ	**Θ==25.03˚**
φn		**=30˚**
η	= (cosθ –μtanλ)/ (cosθ+μ.cotλ) =(cos 25.03 - 0.082 tan 36˚)/(cos 25.03 +0.082* 1/tan 36˚)	**=1.06**
Q1	= (1-η) Pr	= (1-0.0106)*1.46*10 ^3 **=1444.52 W**
SHAFT		
Pr		2HP
Pd		= 2*1.75=2.6*10^3 W
τ_d	=Pd*60*/2л*N	=Pd*60/2л*30 =824.6Nm
GEAR		
Dg		120 mm
r		=120/2=60 mm =0.06m
Ft	τ_d/r	=827.6/0.06 =13793.33N
Fr	Ft*tan 20	=5020.36N
HFD		
Rlh+Rrh		=1379.33
Ml		=0 Ft*0.34-0.68 *Rrh = 0
Rrh		=689.66
Rlh		=689.66
HBMD		
A		= 0
B		= 0
C		=+689.66*0.34=2 34.48 N-mm

D		= (689.66*0.68)-(1379.39*0.34) =0.238 N-mm
E		= (689.66*1.02)-(1379.39*0.68) =0
VFD		
Rlv+Rrv		=5024.36+450+450 =5924.36 N
Ml		=0-(450*0.34) + (5024.36*0.34) - (Rr*0.68) + (450*1.36)
Rrv		=3187.18 N
Rlv		=2737.18 N
VBMD		
A		=0
B		=-(450*0.34) = -153 N-mm
C		=-(450*0.68) + (2737.18*0.34) =624.64 N-mm
D		=-(450*1.02) + (2737.18*0.68)-(5024.36*0.34) =-306 N-mm
E		=-(450*1.36)+ (2737.18*1.02)-(5024.36*0.68) +(3187.18*0.34) = -153 N-mm
RBMD		
A		=0
B		=√0^2+153^2=153 N-mm
C		=√(234.48^2)+(624.64^2) =667.03 N-mm
D		=√ (0.02^2) + (306^2) =306 N-mm
E		=√0 + (-153^2) =153 N-mm
d	**=29.69 mm =3cm.(d=shaft diameter)**	

BEARING DESIGN	
Shaft Calculation	**Values**
Fr	=4201.2N
Fa	=975.32N
N	=30 RPM
Fa/Fr	=975.32/4201.2=0.23=l
X=1, Y=0	
Fe=(X.Fr+Y.Fa). Ks.Ko.Kp.Kr	= (1*4201.2+0+975.32)1*1*1*1*1 =4201.2 N
the L10 life is to be calculated Time=2 years	Time=2*365*24 hrs=17520 hrs =17520*60 min. =1051200 min
L	=Time*N/10^6 =1051200*30/10^6= **31.5 mil rev.**
C	**=7759. 2 N**
Bore diameter	**= 3cm**.