Emergency Vehicle Towing System

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Abstract-*This Topic work deals with the Emergency vehicle towing system an Compressed-air pneumatic actuator that converts one form of energy into another. The emergency vehicle towing system is an eco-friendly towing system which operates with compressed air. This towing system uses the expansion of compressed air to drive the pistons of the pneumatic cylinder. An towing system is a pneumatic actuator that creates useful work by expanding compressed air. There is no mixing of fuel with air as there is no combustion. The Compressed Air Technology is quite simple. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes.*

Keywords-Towing system, Pneumatic actuator, Solenoid valve, Crank.

I. INTRODUCTION

This project Emergency vehicle towing system introduces the towing system which is an pneumatic actuator that monitors with compressed air. It is an eco-friendly which makes use of expansion of compressed air to control the towing system and pneumatic pistons. This towing is a pneumatic actuator which operated on expansion of compressed air. It does not include mixed fuel and combustion. The towing utilizes technology of compressed air for its function. The technology is very easy and simple.

What is towing?

Towing is coupling two or more objects together so that they may be pulled by a designated power source or sources. The towing source may be a motorized land vehicle, vessel, animal, or human, the load anything that can be pulled. These may be joined by a chain, rope, bar, hitch, three-point, fifth wheel, coupling, drawbar, integrated platform, or other means of keeping the objects together while in motion.
The towing uses compressed air technology for its function. It needs lighter metal only because of the absence of elevated temperatures. The compressed air is the fuel which is directly enters into the piston cylinder. It expands in the cylinder and offers required power to the crankshaft. An towing system makes use of Compressed Air Technology for its operation.

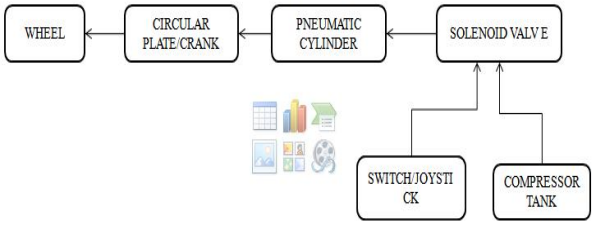
II. LITERARURE SURVEY

Robert Morris Mai Lee Chang[1]: Self-driving vehicle technology to the problem of towing aircraft at busy airports from gate to runway and runway to gate. Autonomous towing can be supervised by human ramp- or ATC controllers, pilots, or ground crew. The controllers provide route information to the tugs, assisted by an automated route planning system. The planning system and tower and ground controllers work in conjunction with the tugs to make tactical decisions during operations to ensure safe and effective taxiing in a highly dynamic environment.

Alan Ali[2]: Optimizing the inter distances between vehicles is very important to reduce traffic congestion on highways. In this paper, a new platoon model and a modification of the variable spacing policy are proposed. This modification is effective to decrease the distances between the cars, making them nearly equal to the constant spacing policy. It also enables increasing string stability. This new approach doesn't require heavy communication between the vehicles.

III. SYSTEM DESCRIPTION

This work is aimed at towing a cost effective smart, secured and safe vehicle system. We have built a prototype model which as shown in fig.



IV. WORKING PRINCIPLE

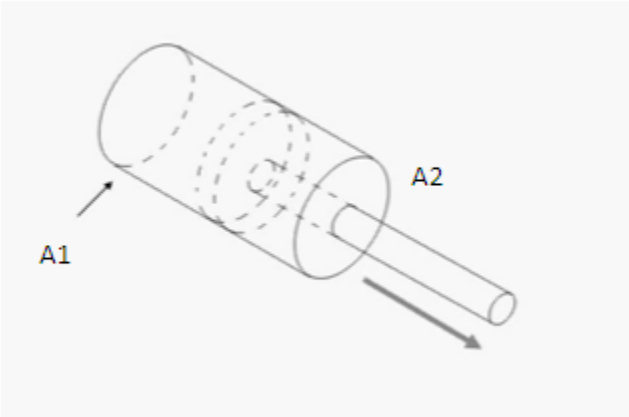
Emergency towing system is useful when fuel over or problem in engine that time we have to call tow truck. we have to built a concept in car to tow the car by itself only.

- Outside of wheel we have to adjust a circular plate as a crank with one hole in distance from center.

- We have to adjust a pneumatic cylinder back of front wheel in this manner which can be fitted to crank plate, both side car front wheels.
- The solenoid valve is used for control the air input and output in pneumatic cylinder.
- Joystick or switch is used for movement of vehicle front or back,
- This system is very useful in car for towing purpose.

V. CALCULATION

Consider,
The weight of our chassis + all components = 20kg
Then the force required to move the vehicle is m*g=20*9.81=196.2 N
Then we have to select the pneumatic cylinder having force of 196.2 N or more …
Hence,
Consider we have to select the piston having bore dia. Is 32mm and stroke 100mm



A1-area of outstroke
A2-area of in stroke
$A1 = \pi r^2$
=r=D/2=32/2=16mm
A1=3.14*16*16
A1=804.25mm
squ……(1)
$A2 = \pi r^2$
A2 = r=D/2=12/2=6mm
From paper of GRANTA piston dia is for 32 bore = 12 mm
A2 = 3.14*6*6
A2 = 113.04mm squ……(2)

Cylinder Type	Bore Size mm	Rod Diameter mm	Piston Cross-section Area cm²	Dynamic effort developed (in daN) at various supply pressures											
				2 bar		4 bar		6 bar		8 bar		10 bar			
Standard	32	12	8.0	6.9	13.0	11.5	30.0	25.0	46.0	40.0	62.0	52.0	77.0	66.0	
	40	16	12.6	10.6	21.0	18.0	46.0	39.0	70.0	59.0	95.0	80.0	122.0	102.5	
	50	20	19.6	16.5	33.0	27.0	70.0	58.0	110.0	92.0	150.0	124.0	190.0	155.0	
	63	20	31.2	28.1	53.0	46.0	110.0	98.0	170.0	154.0	230.0	211.0	290.0	264.0	
	80	25	50.3	45.4	88.0	77.0	185.0	163.0	285.0	255.0	385.0	341.0	480.0	427.0	
	100	25	78.5	73.6	135.0	12.7	290.0	272.0	440.0	412.0	600.0	562.5	750.0	703.0	
	125	32	123.0	115.0	210.0	196.5	460.0	430.0	700.0	654.0	925.0	865.0	1150.0	1075.0	
Compact	20	10	3.1	2.3	5.5	4.0	12.0	9.0	16.0	13.5	23.0	18.0	30.0	22.0	
	25	10	4.9	4.1	8.5	7.0	18.0	15.0	27.0	24.0	38.0	31.0	48.0	39.0	
	32	12	8.0	6.9	13.0	11.5	30.0	25.0	46.0	40.0	62.0	52.0	77.0	66.0	
	40	12	12.6	11.5	21.0	19.0	46.0	42.0	70.0	64.0	95.0	87.0	122.0	111.5	
	50	16	19.6	17.6	33.0	30.0	70.0	64.0	110.0	100.5	150.0	134.0	190.0	170.5	
	63	16	31.2	29.1	53.0	47.5	110.0	101.5	170.0	159.5	230.0	218.5	290.0	273.5	
	80	20	50.7	47.2	88.0	82.0	185.0	172.5	285.0	266.0	385.0	365.5	480.0	457.0	
	100	25	78.5	73.6	135.0	126.5	290.0	272.0	440.0	412.5	600.0	562.5	750.0	703.0	
Round	8	4	0.5	0.4	1.0	0.5	1.5	1.5	2.5	2.0	3.5	2.5	4.5	3.5	
	10	4	0.8	0.6	1.5	1.0	2.5	2.5	4.0	3.5	5.5	4.5	7.5	6.0	
	12	6	1.1	0.8	2.0	1.5	4.0	3.0	6.0	4.5	8.5	6.0	10.5	8.0	
	16	6	2.0	1.7	3.5	3.0	7.5	6.0	10.0	9.0	15.0	12.0	19.0	15.0	
	20	10	3.1	2.3	5.5	4.0	12.0	9.0	16.0	13.5	23.0	18.0	30.0	22.0	
	25	10	4.9	4.1	8.5	7.0	18.0	15.0	27.0	24.0	38.0	31.0	48.0	39.0	
	32	12	8.0	6.9	13.0	11.5	30.0	25.0	46.0	40.0	62.0	52.0	77.0	66.0	
	40	18	12.6	10.0	21.0	17.0	46.0	36.5	70.0	56.0	95.0	75.5	122.0	97.0	
	50	18	19.6	17.0	33.0	29.0	70.0	62.0	110.0	97.0	150.0	130.0	190.0	165.0	
	63	22	31.2	27.4	53.0	44.0	110.0	97.0	170.0	150.0	230.0	200.0	290.0	260.0	

Hence A=A1-A2
=804.25-113.04
=691.21mm squ……(3)
Force =P * A
=minimum pressure is 3 bar but we have to take 4 bar for test the pneumatic cylinder
=0.4 * 691.21 mm squ.
=276.484 N

Then the minimum pressure taken as 3 bar
And the force is 207.363 N
Our force required to move chassis (196.2<207) is less than calculated force.
Pneumatic cylinder is 32 bore and 100 stroke.

Base frame design:

SIZES WITH SECTION WEIGHT OF EQUASQUARE BARS (pipe)

Size	Weight in Kgs.	Gauge	Thickness
in mm	Per Feet	Per Mtr.	
20x20x3	0.274	0.899	3mm
25x25x3	0.335	1.099	3mm
25x25x5	0.548	1.798	3mm
31x31x3	0.390	1.280	3mm

By standard available sizes we select the 25 mm so because that will be easily available and have appropriate size for frame.

Frame design for safety FOR 25*25*3 square pipe mild steel channel

b = 25 mm, d= 25 mm, t = 3 mm.

Consider the maximum load on the frame to be 20 kg.

Max. Bending moment = force*perpendicular distance = 20*9.81*250……(our frame having length is 500*900 then we have taken perpendicular distance of 500=500/2=250mm)

M = 49050 Nmm

We know,

M / I = σb / y

I = bd3 /12

= 25*25^3 / 12

I = 32552.08 mm4

σb = My / I

= 36787.5*12.5 / 32552.08

σb = 18.83 N /mm2

The allowable shear stress for material is σallow = Syt / fos

Where Syt = yield stress = 210 MPa = 210 N/mm2

And fos is factor of safety = 2

So σallow= 210/2 = 105 MPa = 105 N/mm2

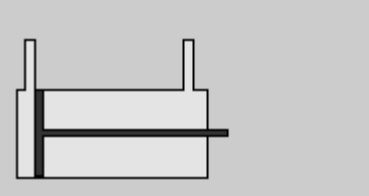
Comparing above we get,

σb<σallow i.e. 18.83< 105 N/mm 2

So design is safe.

Compressor requires for the project.

Air Flow Required for Double-Acting Cylinder



In a double-acting cylinder, the retracting volume and extending volume differ by the displacement of the rod.

The formula for the air consumption of a double-acting pneumatic cylinder is as follows:

- A = Piston Area (Square Inches)
- R= Rod Area (Square Inches)
- S = Stroke (Inches)
- C = Cycles per Minute
- **CFM (Cubic Feet per Minute) = [(2*A - R) x S x C] / 1728**

1 CFM = 28.31 (LPM) Liters Per Minute

A=equation 1

R=equation 2

CFM (Cubic Feet per Minute) = [(2*31.66-4.45)*3.93*20]/1728

CFM=2.68

1 HP = 3 CFM

The compressor requires for our project = 1 HP

VI. ADVANTAGES

- The mechanical design of the towing system is simple and robust.
- Low manufacture and maintenance costs as well as easy maintenance.
- To reduce the work load.
- Compressed air to store the energy instead of batteries
- Reducing pollution from one source, as opposed to the millions of vehicles on the road.

VII. CONCLUSION

We were able to successfully complete the design and fabrication of the emergency vehicle towing system using pneumatic system. By doing this project we gained the knowledge about pneumatic system and how automation can be effectively done with the help of pneumatic system. We were also able to gain practical knowledge about the basics of the normal towing system with solenoid valves. The emergency vehicle towing system provides an effective method for power production and transmission. Even though its applications are limited currently, further research could provide wider applications.

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