MODIFICATION OF A MOTORISED QUADCYCLE

Oigbochie, Donald and Ejiko Samuel Omojola
Department of Mechanical Engineering
The Federal Polytechnic, Ado-Ekiti
donaldson_1601@yahoo.com and jcdatjiko@yahoo.com

ABSTRACT: Transportation is on the increase everyday due to the growth in population. Without transportation, there could be no development in both social and economic aspect, as a pursuit of sufficient and effective transportation; the society needs innovations and creations from those in the field of engineering to device a means to solve the problem. Based on the above, this research work has modified an existing quad cycle to ease transportation. The modification brought about improved rigidity by the use of a thick square iron of 50mm thickness. Its load bearing capacity moved from one passenger to 4 passengers (approximately 310kg). Comfort and stability was achieved by repositioning the wheels from one front, two rear to two front and two rear wheels. The development of the quad cycle was accomplished with a sum of N 232,660.00.

Index terms: Design, load, Quad cycles, passenger, Rigidity, Stability, Transportation,

---

INTRODUCTION

Transportation is essential in the life of man. It is the act of moving people and goods from one place to another. Without transportation there could be no trade and without trade there will be no towns and cities. Towns and cities are traditionally the centre of civilization. Therefore, transportation helps make civilization possible (Rod ford and Richardson, 1978).

History of transportation as presented shows an extremely slow and difficult medium. In ancient time's people travelled mainly on foot. They transported goods on their backs, heads or by dragging them along the ground. In around 5000 BC people began to use animals to haul loads and by 3000 B.C. wagons sailings vessels had been invented. The use of animals, wagons and sailing vessels enabled people to transport loads further and more easily than before. In the early modern times, Europeans built ships capable of making long ocean voyages. The gallon and stage coaches became widely used in Europe. Inventors produced the first engine powered vehicles in the late 1700's and early 1800's; this development marked the beginning of a revolution in transportation (Osho, 2008).

Automobiles, motorcycles, pipeline, snowmobile, trains and trucks are the major engine powered vehicles. All these vehicles except snowmobiles ride on wheels while automobile buses and trucks are the main modern road vehicles in areas where roads are readily available for provision of variety in transportation services. Automobile enable people to travel where they choose. Buses carry passengers between cities and within a city. Trucks can provide door to

door freight service. In Europe and Japan many people drive motorcycles to and from work while in the United States people use motorcycles mainly for recreation.

Unlike motorcycle, motorized quad cycle is designed to move on four wheels; two wheels positioned in the front and other two at the rear. The machine was incorporated with an internal combustion engine which receives heat energy from the burning fuel and converts it into mechanical energy by the action of the piston, connecting rod and crankshaft to provide a convenient transportation for both goods and passengers (Champion and Arnold, 1980).

BRIEF ON FOUR WHEEL DRIVE

Four wheeled vehicle were first built by the Mesopotamians about 3500 B.C but such vehicles were not used until after 3000 B.C. The technique of making wheeled vehicles slowly spread from Mesopotamia to the rest of the world. It got to India about 2,500 B.C, Europe about 1400B.C and china about 1300 B.C (Britannica, 2010).

The first wheeled vehicle was four wheel carts. They were pulled by oxen and after about 3000 B.C by donkey-like animal called onagers.

At first the mesotamians used carts mainly as funeral cars. After 3000 B.C, carts drawn by onagers carried Mesopotamian troops into battle. In the past carts were occasionally used to carry passenger and to haul grain, sand and other goods (Britannica, 2010). The problems frequently encountered in the use of quad cycles in transportation of people and goods hinder economic development. This work highlighted the deficiencies that exist in the previous designs which include the following; Absence of protective covering to prevent the direct effect of sunlight and harsh weather conditions, improper centring and wheel alignment, ineffective suspension system, frequent skidding in negotiating a bend, low efficiency and low bearing capacity. The modified quad cycle possesses an improved rigidity, stability, comfort, load bearing capacity and efficiency for effective performance.

METHODOLOGY

The motorized quadycle is one of the many forms of machine found in common use.itis incorporated with an internal combustion engine which receives heat energy from the burning fuel; this is transformed into mechanical energy by piston, connecting rod and crankshaft eventually reaching the road wheel to propel the vehicle. The engine is the source of the power for the vehicle. For this reason, it is called the power plant. An energy source (gasoline) is burned inside the engine to produce heat. The heat causes expansion (enlargement) of the fuel vapour or gases in the enclosed space or in the engine. The burning and expansion in an enclosed space or combustion chamber produces pressure. The engine piston

connecting rod and crankshaft converts pressure into motion for moving the vehicle and operating its othersystem.

Combustion pressure force the piston by linking the piston to the crankshaft, an engine can produces a powerful spinning motion.The rotating crankshaft can be used to drive gears, chain sand sprockets and other drive mechanisms. The properties of materials make it suitable for particular application. This is conjunction with other important factors have to be considered in choosing materials.

The choice of material in manufacturing affects the product and hence, great care must be taken in selecting them. Quad cycle is designed for moving goods and people and hence subjected to stress. The load may be point load or distributed load. The material should possess internal resistance to meet the load applied to avoid failure. The materials used for the construction were mostly metals which fall under ferrous and non-ferrous metals

Ferrous metals are all those containing iron element or iron alloy, plain carbon steels, alloy steels (a mixture of metals), they are easily attracted by a magnet. Non-ferrous metals are metals not containing iron, not easily attracted by a magnet; they include copper and its alloys, aluminium and its alloys bearing metals.

The ferrous metals are more widely used because they are usually stronger, cheaper than the non-ferrous metals and can be heat treated.non-ferrous metals are used because they resist rusting and corrosion and light in weight, they have low coefficient of friction and low electrical resistance.

DESIGN ANALYSIS

The strength of a metal reflect the load it can withstand without fear of breaking, it is also referred to as safe working stress. The factor of safety is an essential factor which is defined as a simple fraction of tensile strength to the safe working stress of the metal.

Thus factor of safety=tensile strength (stress)/safe working stress.

Bending moment for a simple supported beam (Chassis) as shown in figure 2 is given in equation 1 by Khurmi, (2012), Rajput, (2007), Ejiko *et al.*, (2009).and Ejiko *et al.*, (2015).

Max. Bending moment $M = \frac{WL}{4}$ (1)

= 1885.25Nm

Where,

Maximum load (W) =270kg

Maximum load (N) = 270×9.81= 2646N

Length of chassis (L) =2.85m

Resolution of dividing wheels

Angular velocity of the wheels was determined by using Khurmi and Gupta,

(2012), Akerele and Ejiko, (2015) and Hannah and Stephens (1998) equations as shown in equation 2 and 3.

Linear speed $v = \frac{\pi dN}{60}$ (2)

Where,

d is the wheel diameter = 1.95m

v = 75km/hr.

N=204.02rev/min

Angular velocity of wheels

Angular velocity is determine by using equation 3 as given by Ejiko *et al.,* (2015)

$$\omega = \frac{2\pi N}{60} \quad (3)$$

Angular velocity ω =21.38rads/sec

Engine compression ratio

The engine compression ratio was estimated from Osore, (1999) equation as given in equation 4

$$CR = \frac{V_S + V_C}{V_C} \quad (4)$$

D = 62mm

L = 49.6mm

Where

V_C = clearance volume of the actual engine

V_S = swept volume

$$V_S = \frac{\pi \times 62^2 \times 49.6}{4}$$

V_S = 149463.369mm^3

Based on the swept volume a compression ratio of 9 was selectected

$$CR = \frac{149463.369 + V_C}{V_C}$$

V_C = 18682.921mm^3

Area of cylinder bore

Diameter of cylinder bore = 62mm

Area = 0.003m^2

The component parts were designed and fabricated by various methods which include turning, surfacing and drilling. Facilities utilize for construction were the marking out table, drilling machine and grinding machine, whereas the joining processes involve bolt and nuts, welding and soldering. The finishing operation was done smoothing, filling and painting.

RESULT

Stability of the machine was achieved through the repositioning of the wheels by fixing two wheels in front and two wheels at the rear. Rigidity was increased by using a square metal pipe of 50mm thickness for the chassis constructions. Comfort ability was achieved by providing seats with back rest, roofing and windscreen. Leaf spring suspension systems were applied at rear axle and additional seats were included to

increase load bearing capacity. The rigidity, comfort ability, and load bearing capacity helped in providing safety, unlike in the previous design. Diagrams of the steering system assemble machine isometric and front views are given in Figures 1, 3 and 4 respectively while Table 1 indicates the machine parameters and specifications. Table 2, 3 and 4 indicate the economic cost analysis, job description cost and the overall cost.

TABLE 1: MACHINE PARAMETERS AND SPECIFICATIONS

S/no	Items	Specifications
1	Length	2850mm
2	Width	815mm
3	Height	6ft
4	Seat level to ground	2.5ft
5	Load bearing capacity	310kg
6	Fuel tank capacity	10litres
7	Speed	75km/hr
8	Fuel consumption	2litre per 100km
9	Starting method	Electrical
10	Ignition system	CDI electronic
11	Spark plug type	C7 HAS: japan NGK
12	Front tyre size	12 ring
13	Rear tyre size	12 ring
14	Battery	12volt 4AH/10H
15	Spark plug gap	0.3-0.5mm

TABLE 2: ECONOMIC COST ANALYSIS

S/no	Part/material description piece	Unit	QUANTITY	UNIT (₦)	Cost (₦)
1	Square pipe 50m×50m	Piece	6	1550	9300
2	Mild steel sheet	Sheet	3	8580	25740
3	Flat iron bar	Piece	3	1350	4050
4	Fuel tank	Piece	1	3500	3500

5	Grinding disk	Piece	4	500	2000
6	Spark plug	Piece	4	150	600
5	Cutting disk	Piece	5	450	2250
7	CDI	Piece	1	1500	1500
9	Rims	Piece	5	2850	14250
10	Tube	Piece	5	1200	6000
11	Tyre	Piece	5	4500	22500
12	Exhaust system	Piece	1	3570	3570
13	Propeller shaft	Piece	1	4500	4500
14	Gear oil	Piece	1	950	950
15	Reverse lever	Piece	1	14450	1500
16	Coil spring	piece	1	1500	2500
17	Leaf spring	piece	2	1250	7000
18	Steaming wheel	piece	2	3500	1450
19	Storage battery	piece	2	2850	2850
20	Tyre rod	piece	2	2800	2800
21	Steering axle	piece	1	1500	1500
22	Braking	piece	1	3500	3500
23	4 stroke engine	Piece	1	2075	20750
24	Engine oil	litre	1	750	750
25	Electrodes	Packet	1	1450	7250
26	Mud guard	Piece	1	2850	2850
27	Rear axle	Piece	1	35350	35350
28	Petrol	Litres	20	65	1300
29	Gear box	Piece	1	14450	14450
					₦ 232,600

TABLE 3: JOB DESCRIPTION

S/NO	Job description	Cost
1	Workshop charges/service	8300
2	Electrical work	1500
3	Mechanical work	6000
4	New battery charging	200
5	Painting and fuel	2500

6	TOTAL	₦ 18500

TRANSPORTATION COST

This includes all transport expenses incurred in the course of this work. The cost of transporting of materials from the purchasing site and the process of carrying out field research amounted to ₦ 8500.

OVERALL COST

The overall cost incurred in the course of this work is ₦232,660.00 as shown in Table 4.

TABLE 4: OVERALL COST INCURED

DESCRIPTION	TOTAL COST(₦)
Cost of material	203,660
Cost of labour	18500
Transportation	10500
Overall cost(N)	₦ 232,660

CONCLUSION

Having carried out the necessary modification the following parameters; stability, rigidity and load bearing capacity was improved. A technically simple, less expensive less sophisticated quad cycle ideal for both goods and passengers was produced with an overall cost of ₦232,660.00.

RECOMMENDATIONS

The work force involved should be reduced to minimize the overall cost of production. More accessories should be added to subsequent design for beauty and aesthetics.

REFERENCES

Akerele O. V. and Ejiko S. O. (2015): "Design and Construction of Oil Expeller" International Journal of Engineering and Computer Science India Vol 4, Iss. 6 www.ijecs.in pp 12529-12538

Champion and Arnold (1980): "Motor Vehicle Calculation and Science (SI Unit)" 3rd edition Richard clay Chancer press Ltd Great Britain.

Ejiko S. O., Adelegan G. O. and Dirisu N. O. (2009): "Development and Performance Evaluation of a wear Testing Equipment" Journal of Engineering & earth Sciences (JEES) Vol 4, No 2 pp 6-11

Ejiko S. O., Adu, J. T. and Osayomi P. (2015): "Design and Fabrication of Groundnut Shelling Machine" Grin Research Journal http://m.grin.com/document/306848. Pp 1-23

Ejiko S. O., Momoh, J. J. and Maliki O. B (2015): "Design and Construction of a Drill grinding Attachment to Machine Shop Pedestal Grinder" Journal of Engineering & earth Sciences (JEES) Vol 9, No 1 pp 47-54

Hannah J. and Stephens R. C. (1998): "Mechanics of Machines" 2nd Edition, Arnold Publisher Ltd. London pp 52 -61

Khurmi R. S. (2012): "Strength of Materials" 23rd Edition, S. Chand & Company Ltd. Ram Nagar, New Delhi - 110055 pp 510-513

Khurmi R. S. and Gupta J. K. (2012): "Theory of Machines" 14th Edition, S. Chand & Company Ltd. Ram Nagar, New Delhi - 110055 pp 17-19

Odior, A. O., Oyawale,F. A., Oyedepo S.O and Aasa, S. A. (2013):"Theoretical Considerations of Machining with Grinding Wheels" International Journal of Engineering and Technology,2(2)126-133

Osho B.O (2008): "Project report on motorized quad cycle for physically challenged" federal polytechnic Bida Niger state, Nigeria

Osore O. A. (1999): "Essentials of Classical Thermodynamics" 1st Edition, IPS Educational Press, Ilaro, Ogun State, Nigeria pp 191- 193

Rajput R. K. (2007): "Strength of Material (Mechanics of Solids)".S.channel and company ltd New Delhi, India.

Rodford J.D. and Richardson B. B. (1978):"Engineering Technology" 2nd Edition, Hodir and Stoughton Ltd, London

Britannica (2010): "encyclopaedia on a four wheel drive system" www.britannica.com/.../sport/utility-vehicle Retrieved on the 20th of June, 2010.

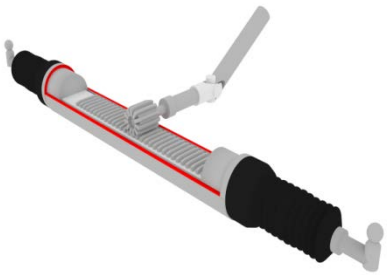

Fig 1: Machine Steering System

Fig 2: Chassis diagram

Fig 3: Assemble machine diagram

Fig 4: Front view of Quad cycle