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Review TMET

Development of an Easy Car Moving Kit Using a Hydraulic Cylinder

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Abstract

A wheel dolly that can be used as an automotive jack and can support heavy loads in the air for lengthy periods without the need for hydraulic systems is revealed. In a further aspect, when the vehicle's engine fails, and is not able to move on its own, to move the vehicle with the help of human power or another vehicle is taken. For moving a car, portable dolly kits are available in the market, but they come with a lengthy procedure for usage of those kits. Firstly, the car needs to lift from the ground and then dolly kits are placed under the tire, after that hydraulic jacks are removed after placing dollies under the tire. When a car is being restored, repaired or just moved around in a large storage facility, there are times when it needs to get from one place in a garage to another without the use of its engine. Sometimes it needs to be at a different angle to repair work a little easier. In other situations, it may need to wedge into place among tightly packed vehicles. That's where car dollies, sometimes called car skates, come in. They lift the car and support its weight while it's rolled or pivoted into position.

Keywords: Hydraulic cylinder, car moving kit, vehicle lifting mechanism, hydraulic system, portable dolly kits

INTRODUCTION

When a vehicle (car, three-wheeler) engine fails, and it is not able to move on its own, the vehicle with the help of human power or another vehicle is taken [1–4]. For moving a car, portable dolly kits are available in the market, but they come with a lengthy procedure for usage [5]. First, the car needs to be lifted from the ground and then dolly kits are placed under the tire, and then hydraulic jacks are removed after placing dollies on the tire. Car dollies are used in art for lifting and moving heavy-vehicle wheels [6–8]. This system can raise wheels that are fixed to an automobile, separate, or pair. If a vehicle's mechanisms have caster wheels, it can be moved around a shop to use up space when all its wheels are raised [9, 10]. Dollies typically have two arms that pinch horizontally in the wheel direction. The wheel is raised by the upward force vector provided by the two arms (as well as the two inward vectors that cut each other out). A lifting mechanism may have raised two parallel supporting arms upward, and the arms supported wheel lifting [11–13].

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Existing Method of Car Moving

- Using simple dolly and hydraulic jack
- Time consumption is more
- Chances of slipping tire from dolly

In the existing method, simple dollies are used, and a hydraulic jack is used for lifting. This existing method is time-consuming and dangerous. First, in

this method, the car tire is lifted from the ground using a hydraulic jack. A simple dolly is placed under the tire. Release the jack pressure and tire placed on the dolly, and the operation is complete.

The simple car moving dolly is working, but this method is time-consuming, and in this method, there are more chances of slipping the tire from the dolly, and the car may be damaged or cause injury. This method requires high human effort and is dangerous to human health.

Drawbacks of Previous Existing Car Moving Dolly Method

- It requires a lot of time.
- Multiple pieces of equipment are needed for setup.
- It requires more human effort.
- Because of the simple car moving dolly, there is a chance of the tire slipping from the dolly.

PROBLEM DEFINITION

Positioning cars in garages and showrooms for optimal displays can be difficult owing to space and infrastructure constraints. To address this, we are developing a hydraulic car moving kit that minimizes human effort and costs. Existing car dollies often lack the freedom necessary for precise positioning. Many use horizontal parallel arms to lift a wheel, but their vertical movement is limited by fixed arm heights. Other dollies lift wheels vertically but are difficult to position because of fixed or non-adjustable arms. Some designs have arms that are too wide, losing vertical travel, while others are too narrow for larger wheels, making them unusable. Our hydraulic kit aims to overcome these issues by offering greater flexibility and ease of use, and by improving the precision and efficiency of car positioning.

OBJECTIVE

- To reduce human effort is required to move cars in garages.
- To minimize costs associated with vehicle movement.
- To simplify the lifting process for improved efficiency.
- To reduce risks involved in lifting a car.
- To streamline the operational mechanism for lifting and moving vehicles.
- To prevent damage to the car during movement.

LITERATURE REVIEW

Mason Jess Winters (2015) invented a wheel dolly designed to support and lift the car tire of a small airplane during taxiing. It safely lifts a flat tire off the ground, thereby allowing the airplane to be towed from the runway. The dolly can handle wheels up to 35 inches in diameter and 10 inches wide and weighs up to 8,700 pounds.

Danny R. Minor (2015): The vehicle wheel lift and turn gadget features a U-shaped support frame with two opposing sides to engage the vehicle wheel. Rotatable lift arms with rollers are in contact with the wheel. A front-mounted jack connected to the lift arms via chains moves the arms to lift the wheel.

Richard N. Heinz (2015): A jack and dolly set to raise a vehicle's wheels is the subject of the invention. In particular, the device is connected to a remote jack and cart assembly to lift and then move an automobile suspended in the assembly. The group believes that the vehicle flows around an infinite number of tomahawks in a single plane.

Kenneth LaBruyere (2014): In general, the invention refers to devices that raise and move automobiles across surfaces; in particular, it concerns a vehicle wheel dolly that can be used to raise a car without the need for vehicle lifting gear. It is frequently necessary to move cars by hand around a storage area or service garage without using the vehicle's power. Pushing cars around the garage by hand using their own four wheels and tires is one method of moving them.

Curtis C. Hassell (2014): The disclosure describes a self-loading mini dolly with a frame, front and rear arms, and wheeled axles. Both the front and rear platforms can be deployed between the lowered and raised positions using a lever bar, enabling easy lifting and movement.

Stuart G. Ullman (2011): This dolly was designed for lifting and maneuvering vehicles with tires. It features an adjustable U-shaped frame with the first and second edge members contacting the opposite sides of the tire. It includes a lift and support mechanism, an extending arm, and a tractor with four lift supports attached to the arm.

Doug Symiczek (2008): This automotive dolly system securely connects to disabled vehicles, allowing for easy movement. This supports multiple vehicle types and locations. The system includes a dolly with a base, first support, and second support for temporary vehicles at various locations.

Arden Royce Shubert, Fort Collins (2007): The wheel dolly was created for towing and recovering vehicles. In this Project, the invented simple wheel dolly does not work for the lifting process with the use of another jack; the car is first lifted and then fixed below the car wheel, and then it works.

Hector Ray Hernandez, Fullerton (2006): This vehicle jack and wheel dolly act as both a car jack and dolly and can hold heavy loads for extended periods using only mechanical systems, eliminating hydraulics. It features lifting components operated by a single nut with standardized dimensions, allowing operation with one driver and a socket.

Patrick J. Whelan (2004): Traditional methods of moving a disabled vehicle include pushing, pulling, or towing, which can be inconvenient and may cause damage. Towing vehicles are expensive and difficult to operate. Trailers designed to be pulled also pose challenges if no towing vehicle is available, making movement impossible in such cases.

Wang Gang (2003) invented Wheel Skate, a U-shaped frame roller-skates for vehicle wheels, allowing movement in confined spaces. The adjustable frame engages both sides of the tire, and the foot pedal lever contracts the frame to lift the tire off the garage floor.

Paul Saffelle (2000): This assembly lifts and supports a single vehicle tire while it is mounted. It features two tire lift paddles connected to the lift arms. Without a separate jack, the paddles slide under the tire, and when the lift axle is operated, the tire is lifted and secured with a lip.

DESIGN, MECHANISM AND FABRICATION

Vehicle mobility in tight areas, such as workshops, is made easier using an Easy Car Moving Kit, which uses a hydraulic cylinder. It is composed of wheels, a hydraulic pump, a piston-cylinder mechanism, and a strong foundation frame. Pascal's law governs how the system works: hydraulic pressure raises the car slightly to make moving easier. Choosing, cutting, welding, and assembling materials are all parts of fabrication; mild steel or aluminum is used for strength and longevity. The hydraulic system guarantees effortless lifting and lowering through carefully regulated valves. This innovative kit enhances efficiency, reduces manual labor, and improves safety, making it highly beneficial for automotive maintenance and repair.

Design of Frame

The frame fabricated for our project consisted of an M.S. It was welded according to the arrangement of the system components.

Frame Specification

- *Size of frame:* 580 × 465 mm
- *Material of frame:* Mild steel
- *Loaded weight of frame:* Approximately 7 kg

For making and developing a car moving kit, the following steps are followed.

We considered the number of specifications for the car tire size and weight of the first car: the Maruti Suzuki 800 and Maruti Suzuki Alto, respectively. The tire size of the Maruti Suzuki 800 was 145/70 R12.

- *We calculated the specifications of the Maruti Suzuki 800*
  Tire height (diameter) = 508 mm
  Wheel size = 305 mm
  Sidewall height = 102 mm
  Tire width = 145 mm
  Tire circumference = 1595 mm

- *The gross weight of the Maruti Suzuki 800 car is 620 kg.*
  After determining the weight of the car, it was necessary to calculate the weight distribution on each tire.
  Total weight = 620 kg
  Weight on single tire = total weight/4
  = 620/4
  = 155 kg approx. on each tire

- The tire size of the *Maruti Suzuki Alto* is *145/80 R12.*
  We calculated the specifications of the Maruti Suzuki Alto.
  Tire height (diameter): 537 mm
  Tire width: 145 mm
  Sidewall height: 116 mm
  Rim size: 305 mm
  Tire circumference: 1687 mm
  Gross weight of car: 1185 kg

- *The gross weight of the Maruti Suzuki Alto car is 1185 kg.*
  After determining the gross weight of the car, it was necessary to calculate the weight distribution on each tire.
  Total weight = 1185 kg
  Weight on single tire = total weight/4
  = 1185/4
  = 286 kg approx. on each tire

- After calculating the weight distribution on each tire of the cars, we calculated the size of the frame that we needed to place around the tire.

  To place the frame around the tire of the Maruti Suzuki 800, the frame needs to expand by more than 508 mm.

  Then, we calculated the minimum distance needed for lifting the tire from the ground at 350 mm.

  We then made an Auto-Cad drawing to clarify doubts about the tire and ground interaction.

- Force calculation of hydraulic cylinder
  Formula
  Force (F) = Pressure (P) × Area (A)
  Given

Hydraulic pressure (P)= 153 kg/cm^2
Piston diameter (D) = 4 cm

R = 2 cm
Piston Rod Diameter (d) = 2.5 cm
r = 1.25 cm

Total Piston Area =3.14 × r2
= 3.14 × 2×2
= 12.56 cm^2

Piston Rod Area = 3.14 × r2
= 3.14 ×1.25 ×1.25
= 4.9062 cm^2

Actual Piston Area = Total Piston Area – Piston Rod Area
= 12.56- 4.9062
= 7.65 cm^2

Force (F) = Pressure(P) × Area (A)
= 153 × 7.65
= 1171.93 kg
F = 1.17 Ton

The total Force of Hydraulic Cylinder is 1.17 Ton

2D Design of the Frame of Car Moving Kit

A 2D design of the frame of a car moving kit is a technical drawing that represents the structural layout of the chassis from a top, front, or side view. It includes precise dimensions, wheel mounting points, motor placements, and slots for electronic components. This design serves as a blueprint for manufacturing and assembly, ensuring the accurate positioning of all parts for smooth movement and stability (Figure 1).

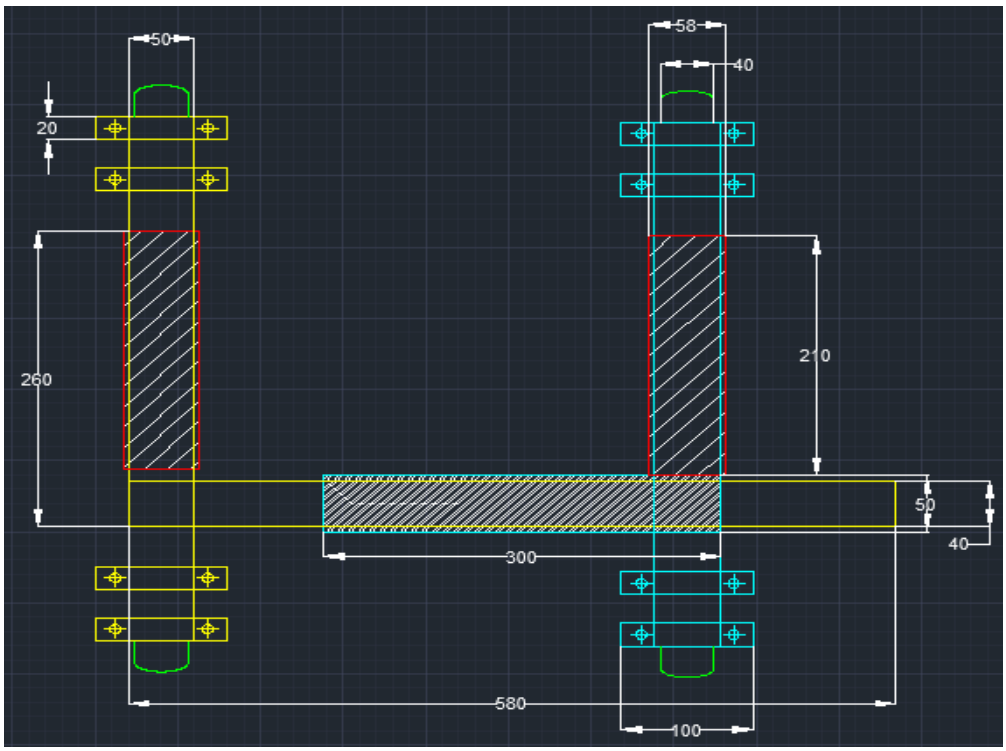

Figure 1. 2D diagram of car moving kit frame.

3D Diagrams of the Car Moving Kit Frame

The 3D diagram of a car moving kit frame visually represents the structural layout, showcasing the base frame, wheel mounting points, motor placements, and space for electronics, such as batteries and controllers. This helps in understanding the assembly process and ensuring proper alignment of components for efficient movement and functionality (Figures 2 and 3).

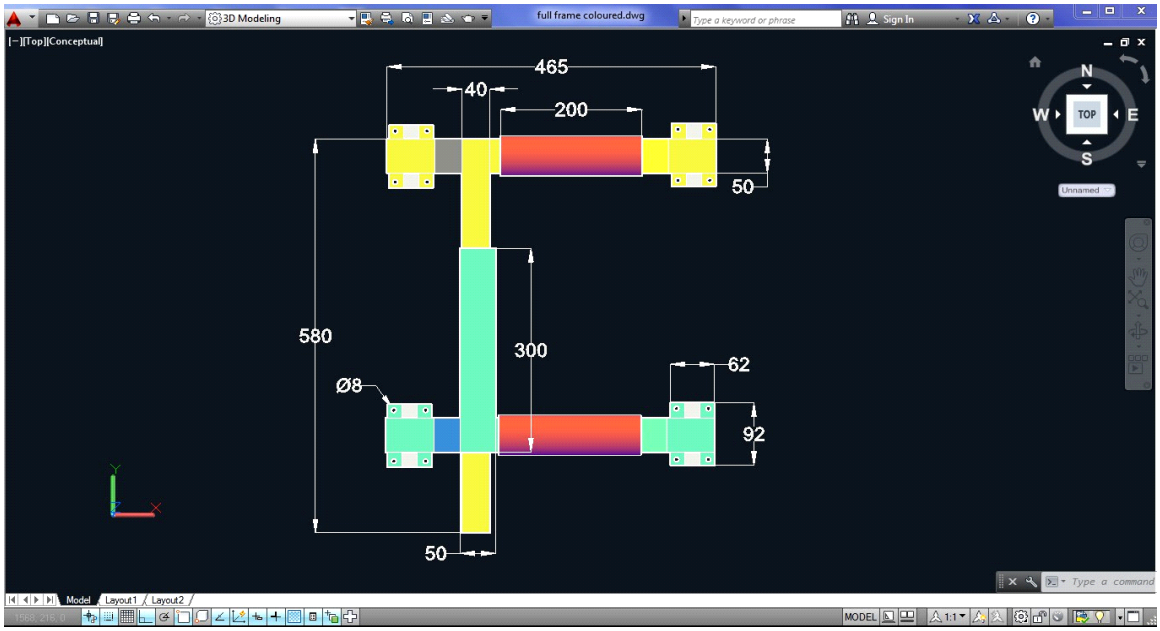

Figure 2. Top view.

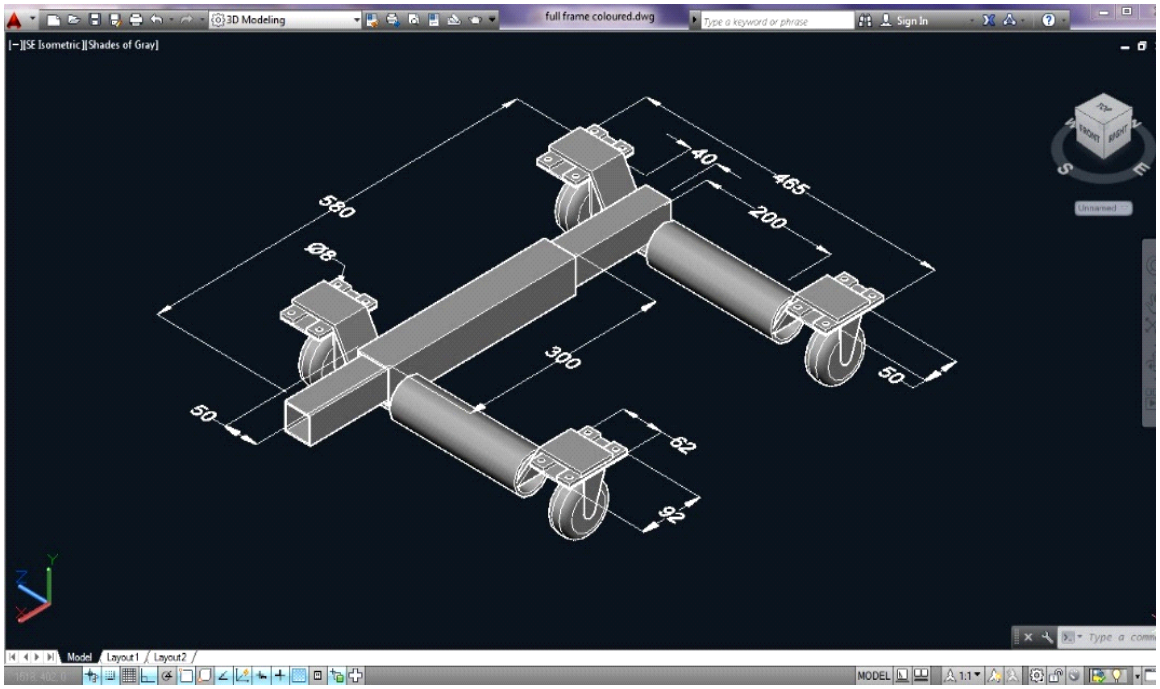

Figure 3. Isometric view.

Bill of Material

The bill of materials (BOM) lists all the components required for the fabrication and assembly of an Easy Car Moving Kit. It includes details such as the components, material type, quantity, and cast (Table 1).

Frame Assembly

The frame assembly is a crucial step in ensuring the structural stability and durability of an easy-to-use car moving kit. *For strength and portability, mild steel or aluminum are commonly used to make the frame***.** The fabrication process involves cutting, welding, and bolting the framed components according to the design specifications. The hydraulic cylinder and wheels were securely mounted on the frame to ensure smooth lifting and movement. Once assembled, the frame underwent alignment checks and load testing to verify the stability and operational efficiency (Figures 4 and 5).

Table 1. Bill of material.

S.N.	Components	Material	Quantity	Cost in Rs.
1	Outer Square Pipe	Mild Steel	1	500
2	Inner Square Pipe	Mild Steel	1	500
3	Supporting Arm	Mild Steel	2	400
4	Flat Metal Strip	Mild Steel	8	200
5	Roller Pipe	PVC	2	300
6	Caster Wheel	Polyurethane+SS Bracket	4	1000
7	Hydraulic Cylinder	Mild Steel	1	7000
8	Hydraulic Pump (Rent)	-	1	1000
9	Nuts/Bolts	Cast iron	20	200
10	Washer	Mild Steel	20	100
11	Fabrication Cost	-		3000
	Total			**14200/-**

Figure 4. Assembly of car moving kit frame.

Figure 5. Assembly of car moving kit with cylinder.

Testing

The testing process ensures the efficiency, safety, and reliability of an Easy Car Moving Kit. Initially, a load test was conducted by placing different vehicle weights on the system to verify lifting capacity and stability. A hydraulic pressure test checks for leaks and ensures smooth operation of the piston-cylinder mechanism. The mobility test evaluates the ease with which a car can be moved once it is lifted. In addition, durability tests are used to assess the long-term performance of materials under repeated use. After multiple trials, adjustments were made to optimize performance, ensuring that the kit met safety standards and practical usability (Figures 6 and 7) (Table 2).

Figure 6. Car moving kit testing on Maruti Suzuki 800.

Figure 7. Testing of easy car moving kit on Maruti Alto 800.

Table 2. Testing.

Vehicle name	Tire size	Lifting height (from the ground)	Remark (testing)
Maruti 800	145/70 R12	20 mm	OK
Maruti 800 Alto	145/80 R12	25 mm	OK
Maruti Wagon R	155/80 R13	40 mm	OK

Future Scope

- Other operations can also be performed using this machine.
- The machine can be made more portable.
- Cost can also be reduced to some extent by manufacturing it on a mass scale.
- Atomization systems are also possible in the future
- After some improvement in the load factor, it can be used for heavy vehicles

CONCLUSION

The current invention offers an easy-to-use wheel dolly that fits the wheels of most manufacturing, construction, and agricultural equipment, as well as numerous aircraft. Both fully overstated tires installed on unbroken wheels and broken wheels with flat tires could be carried using a wheel dolly. As readily as it can carry wheels that rotate, the wheel dolly can also convey locked or non-rotating wheels. This wheel dolly can be made with steel rollers that can roll over obstacles and slip sideways across terrain, or with durable rubber rollers for usage on streets and roads. Large trucks that require a low lift height to pass around barriers may be transported on roads using a combination of pneumatic tires. All the vehicle's wheels can be carried by the current invention when utilized alone, in pairs, or sets. Only the wheel it transmits, the vehicle at one or both ends, or another wheel dollies can be protected. Solid axle coverings, which are found in most trucks as well as in manufacturing and agricultural equipment, can also be found near wheel dollies.

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