DESIGN AND FABRICATION OF ETHANOL FUEL ENGINE WITH FOUR STROKES

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Abstract: *The main aim of our project is to design and fabricate an ethanol powered four strokes two-wheeler vehicle with front wheel electrically driven. An Ethanol fuel engine is an alternative fuel vehicle that uses ethanol as its on-board fuel for motive power. The term may refer to a personal transportation vehicle, such as an automobile, or any other vehicle that uses ethanol in a similar fashion, such as an aircraft. The power plants of such vehicles convert the chemical energy of ethanol to mechanical energy either by burning ethanol in an internal combustion engine, or by reacting ethanol in a fuel cell to run electric motors. Widespread use of ethanol for fueling transportation is a key element of a proposed ethanol economy. Another added advantage of our project is that the vehicle acts as an electrically driven vehicle with a hub motor and a battery. The ethanol powered engine delivers power to the rear wheels and the front wheels are pushed by the rear wheels, whereas in electrical driving the hub motor delivers power to the front wheels and the front wheels in turn push the rear wheels.*

Keywords: **Agricultural feedstock, bio fuel additive, octane rating, photo-voltaic system and Lead-Acid Batteries**.

1. INTRODUCTION

Ethanol fuel is ethanol (ethyl alcohol), the same type of alcohol found in alcoholic beverages. It is most often used as a motor fuel, mainly as a biofuel additive for gasoline. World ethanol production of transport fuel tripled between 2000 and 2007 from 17 billion to more than 52 billion litres. From 2007 to 2008, the share of ethanol in global gasoline type fuel use increased from 3.7% to 5.4%. In 2011 worldwide ethanol fuel production reached 22.36 billion U.S. liquid gallons (bg) (84.6 billion litres), with the United States as the top producer with 13.9 bg (52.6 billion litres), accounting for 62.2% of global production, followed by Brazil with 5.6 bg (21.1 billion litres). Ethanol fuel has a "gasoline gallon equivalency" (GGE) value of 1.5 US gallons (5.7 L), which means 1.5 gallons of ethanol produces the energy of one gallon of gasoline.

Ethanol fuel is widely used in Brazil and in the United States, and together both countries were responsible for 87.1% of the world's ethanol fuel production in 2011. Most cars on the road today in the U.S. can run on blends of up to 10% ethanol, and ethanol represented 10% of the U.S. gasoline fuel supply derived from domestic sources in 2011. Since 1976 the Brazilian government has made it mandatory to blend ethanol with gasoline, and since 2007 the legal blend has been around 25% ethanol and 75% gasoline (E25). By December 2011 Brazil had a fleet of 14.8 million flex-fuel automobiles and light trucks and 1.5 million flex-fuel motorcycles that regularly use neat ethanol fuel (known as E100).

Bioethanol is a form of quasi-renewable energy that can be produced from agricultural feedstocks. It can be made from very common crops such as sugar cane, potato, manioc and corn. There has been considerable debate about how useful bio ethanol will be in replacing gasoline. Concerns about its production and use relate to increased food prices due to the large amount of arable land required for crops, as well as the energy and pollution balance of the whole cycle of ethanol production, especially from corn. Recent developments with cellulosic ethanol production and commercialization may allay some of these concerns.

Cellulosic ethanol offers promise because cellulose fibers, a major and universal component of plant cell walls, can be used to produce ethanol. According to the International Energy Agency, cellulosic ethanol could allow ethanol fuels to play a much bigger role in the future than previously thought.

2. LITERATURE REVIEW

Ethanol is most commonly used to power automobiles, though it may be used to power other vehicles, such as farm tractors, boats and airplanes. Ethanol (E100) consumption in an engine has been approximately 51% higher than for gasoline since the energy per unit volume of ethanol is 34% lower than for gasoline. The higher compression ratios in an ethanol-only engine allow for increased power output and better fuel economy than could be obtained with lower compression ratios. In general, ethanol-only engines are tuned to give slightly better power and torque output than gasoline-powered engines. Flexible fuel vehicles, the lower compression ratio require tunings that give the same output when using either gasoline or hydrated ethanol. For maximum use of ethanol's benefits, a much higher compression ratio should be used. Current high compression neat ethanol engine designs are approximately 20 to 30% less fuel more efficient than their gasoline-only counterparts.

Ethanol contains soluble and insoluble contaminants. These soluble contaminants, halide ions such as chloride ions, have a large effect on the corrosivity of alcohol fuels. Halide ions increase corrosion in two ways; they chemically attack passivating oxide films on several metals causing pitting corrosion, and they increase the conductivity of the fuel. Increased electrical conductivity promotes electric, galvanic, and ordinary corrosion in the fuel system. Soluble contaminants, such as aluminium hydroxide, itself a product of corrosion by halide ions, clog the fuel system over time.

Ethanol is hygroscopic, meaning it will absorb water vapor directly from the atmosphere. Because absorbed water dilutes the fuel value of the ethanol (although it suppresses engine knock) and may cause phase separation of ethanol-gasoline blends, containers of ethanol fuels must be kept tightly sealed. This high miscibility with water means that ethanol cannot be efficiently shipped through modern pipelines, like liquid hydrocarbons, over long distances.The Mechanics also have seen increased cases of damage to small engines, in particular, the carburetor, attributable to the increased water retention by ethanol in fuel.

A 2004 MIT study and an earlier paper published by the Society of Automotive Engineers identify a method to exploit the characteristics of fuel ethanol substantially better than mixing it with gasoline. The method presents the possibility of leveraging the use of alcohol to achieve definite improvement over the cost-effectiveness of hybrid electric. The improvement consists of using dual-fuel direct-injection of pure alcohol (or the azeotrope or E85) and gasoline, in any ratio up to 100% of either, in a turbocharged, high compression-ratio, small-displacement engine having performance similar to an engine having twice the displacement. Each fuel is carried separately, with a much smaller tank for alcohol. The high-compression (which increases efficiency) engine will run on ordinary gasoline under low-power cruise conditions. Alcohol is directly injected into the cylinders (and the gasoline injection simultaneously reduced) only when necessary to suppress 'knock' such as when significantly accelerating. Direct cylinder injection raised the already high-octane rating of ethanol up to an effective 130. The calculated over-all reduction of gasoline uses and CO_2 emission is 30%. The consumer cost payback time shows a 4:1 improvement over turbo-diesel and a 5:1 improvement over hybrid. The problems of water absorption into pre-mixed gasoline (causing phase separation), supply issues of multiple mix ratios and cold-weather starting are also avoided.

Ethanol's higher-octane rating allows an increase of an engine's compression ratio for increased efficiency. In one study, complex engine controls and increased exhaust gas recirculation allowed a compression ratio of 19.5 with fuels ranging from neat ethanol to E50. Thermal efficiency up to approximately that for a diesel was achieved. This would result in the fuel economy of a neat ethanol vehicle to be about the same as one burning gasoline.

Since 1989 there have also been ethanol engines based on the diesel principle operating in Sweden. They are used primarily in city buses, but also in distribution trucks and waste collectors. The engines, made by Scania, have a modified compression ratio and the fuel (known as ED95) used is a mix of 93.6% ethanol and 3.6% ignition improver, and 2.8% denaturants. The ignition improver makes it possible for the fuel to ignite in the diesel combustion cycle. It is then also possible to use the energy efficiency of the diesel principle with ethanol. These engines have been used in the United Kingdom by Reading Transport but the use of bioethanol fuel is now being phased out.

3. COMPONENTS AND DESCRIPTION

The major components involved in the design and the fabrication of the ethanol powered four strokes two-wheeler vehicle with front wheel electric drive are as follows.

a) Battery,
b) Hub motor.
c) Engine,
d) Sprocket and chain drive,
e) Bearing with bearing cap.

3.1. Battery

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact, for small units with output less than one kilowatt.

Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties:

a) Low cost
b) Long life
c) High reliability
d) High overall efficiency
e) Low discharge
f) Minimum maintenance
g) Ampere hour efficiency
h) Watt hour efficiency

We use lead acid battery for storing the electrical energy from the solar panel for lighting the street and so about the lead acid cells are explained below.

3.2. Lead-Acid Wet Cell

Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H2SO4). In the application of battery power to start the engine in an automobile, for example, the load current to the starter motor is typically 200 to 400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6-V battery and six for a 12-V battery.

The lead acid cell type is a secondary cell or storage cell, which can be recharged as shown in figure1. The charge and discharge cycle can be repeated many times to restore the output voltage, as long as the cell is in good physical condition. However, heat by excessive charge and discharge currents shortened the useful life to about 3 to 5 years for an automobile battery. Of the different types of secondary cells, the lead-acid type has the highest output voltage, which allows fewer cells for a specified battery voltage.

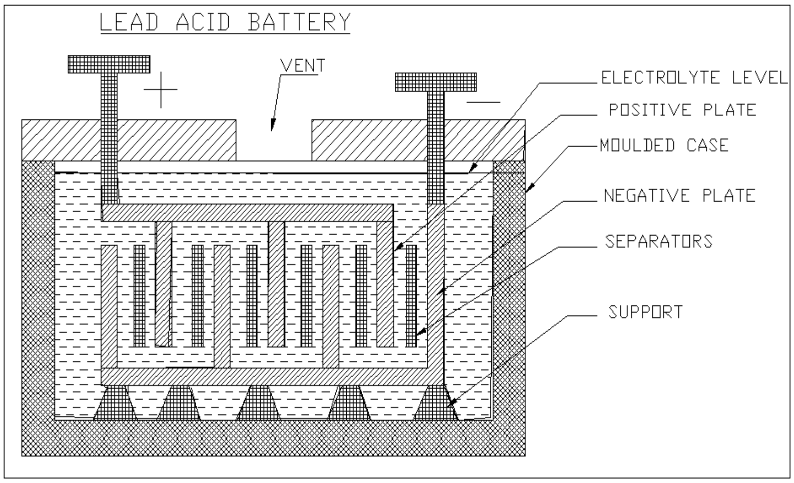

Figure 1.Lead Acid Battery

3.3. Construction

Inside a lead-acid battery, the positive and negative electrodes consist of a group of plates welded to a connecting strap. The plates are immersed in the electrolyte, consisting of 8 parts of water to 3 parts of concentrated sulfuric acid. Each plate is a grid or framework, made of a lead-antimony alloy. This construction enables the active material, which is lead oxide, to be pasted into the grid. In the manufacture of the cell, a forming charge produces the positive and negative electrodes. In the forming process, the active material in the positive plate is changed to lead peroxide (pbo_2). The negative electrode is spongy lead (pb).

Automobile batteries are usually shipped dry from the manufacturer. The electrolyte is put in at the time of installation, and then the battery is charged from the plates. With maintenance-free batteries, little or no water need be added in normal service. Some types are sealed, except for a pressure vent, without provision for adding water.

The construction parts of the battery are shown in figure.

3.4. Chemical Action

Sulfuric acid is a combination of hydrogen and sulfate ions. When the cell discharges, lead peroxide from the positive electrode combine with hydrogen ions to form water and with sulfate ions to form lead sulfate. Combining lead on the negative plate with sulfate ions also produces he sulfate. Therefore, the net result of discharge is to produce more water, which dilutes the electrolyte, and to form lead sulfate on the plates.

As the discharge continues, the sulfate fills the pores of the grids, retarding circulation of acid in the active material. Lead sulfate is the powder often seen on the outside terminals of old batteries. When the combination of weak electrolyte and sulphating on the plate lowers the output of the battery, charging is necessary.

On charge, the external D.C. source reverses the current in the battery. The reversed direction of ions flows in the electrolyte result in a reversal of the chemical reactions. Now the lead sulphates on the positive plate reactive with the water and sulfate ions to produce lead peroxide and sulfuric acid. This action re-forms the positive plates and makes the electrolyte stronger by adding sulfuric acid.

At the same time, charging enables the lead sulfate on the negative plate to react with hydrogen ions; this also forms sulfuric acid while reforming lead on the negative plate to react with hydrogen ions; this also forms currents can restore the cell to full output, with lead peroxide on the positive plates, spongy lead on the negative plate, and the required concentration of sulfuric acid in the electrolyte.

3.5. Caring for Lead-Acid Batteries

Always use extreme caution when handling batteries and electrolyte. Wear gloves, goggles and old clothes. “Battery acid” will burn skin and eyes and destroy cotton and wool clothing.

The quickest way of ruin lead-acid batteries is to discharge them deeply and leave them stand “dead” for an extended period of time. When they discharge, there is a chemical change in the positive plates of the battery. They change from lead oxide when the charge out lead sulfate when discharged. If they remain in the lead Sulfate State for a few days, some part of the plate dose not returns to lead oxide when the battery is recharged. If the battery remains discharge longer, a greater amount of the positive plate will remain lead sulfate. The parts of the plates that become “sulfate” no longer store energy. Batteries that are deeply discharged, and then charged partially on a regular basis can fail in less than one year.

Check your batteries on a regular basis to be sure they are getting charged. Use a hydrometer to check the specific gravity of your lead acid batteries. If batteries are cycled very deeply and then recharged quickly, the specific gravity reading will be lower than it should because the electrolyte at the top of the battery may not have mixed with the “charged” electrolyte.

Check the electrolyte level in the wet-cell batteries at the least four times a year and top each cell with distilled water. Do not add water to discharged batteries. The Electrolyte is absorbed when batteries are much discharged. If you add water at this time, and then recharge the battery, electrolyte will overflow and make a mess.

Keep the top of your batteries clean and check that cables are tight. Do not tighten or remove cables while charging or discharging. Any spark around batteries can cause a hydrogen explosion inside, and ruin one of the cells, and you.

On charge, with reverse current through the electrolyte, the chemical action is reversed. Then the pb ions from the lead sulfate on the right side of the equation re-form the lead and lead peroxide electrodes. Also, the SO_4 ions combine with H_2 ions from the water to produce more sulfuric acid at the left side of the equation.

3.6. Charging the Lead-Acid Battery

The requirements are illustrated in figure. An external D.C. voltage source is necessary to produce current in one direction. Also, the charging voltage must be more than the battery e.m.f. Approximately 2.5 per cell are enough to over the cell e.m.f. So that the charging voltage can produce current opposite to the direction of discharge current.

Note that the reversal of current is obtained just by connecting the battery VB and charging source VG with + to + and –to-, as shown in figure. The charging current is reversed because the battery, effectively becomes a load resistance for VG when its higher than VB. In this example, the net voltage available to produce charging currents is 15-12=3V.

A commercial charger for automobile batteries is essentially a D.C. power supply, rectifying input from the AC power line to provide D.C. output for charging batteries.

Float charging refers to a method in which the charger and the battery are always connected to each other for supplying current to the load. In the figure the charger provides current for the load and the current necessary to keep the battery fully charged. The battery here is an auxiliary source of D.C. power.

It may be of interest to note that an automotive battery is in a floating-charge circuit. The battery charger is an AC generator or alternator with rectifier diodes, driven by a belt from the engine. When you start the car, the battery supplies the cranking power. Once the engine is running, the alternator charges he battery. It is not necessary for the car to be moved. A voltage regulator is used in this system to maintain the output at approximately 13 to 15 V.

The constant voltage of 24V comes from the solar panel controlled by the charge controller so for storing this energy we need a 24V battery so two 12V batteries are connected in series.

It is a good idea to do an equalizing charge when some cells show a variation of 0.05 specific gravity from each other. This is a long steady overcharge, bringing the battery to a gassing or bubbling state. Do not equalize sealed or gel type batteries.

With proper care, lead-acid batteries will have a long service life and work very well in almost any power system. Unfortunately, with poor treatment lead-acid battery life will be very short.

3.7. Hub Motor

Figure 2.Hub motor

The hub motor is an electric motor that is incorporated into the hub of a wheel and drives it directly (shown in Figure 2). This motor is used to drive the mop. The mop attains its motion from the hub motor and rotates and perform the cleaning operation.

3.8. Engine

An engine or motor is a machine designed to convert one form of energy into mechanical energy. Heat engines, including internal combustion engines and external combustion engines (such as steam engines) burn a fuel to create heat, which then creates a force. Electric motors convert electrical energy into mechanical motion, pneumatic motors use compressed air and others—such as clockwork motors in windup toys—

use elastic energy. In biological systems, molecular motors, like myosin's in muscles, use chemical energy to create forces and eventually motion.

In our project we use a sample engine which drives a wheel by a chain drive in order to show the exact working of the anti-theft system using GSM.

A four-stroke cycle engine is an internal combustion engine that utilizes four distinct piston strokes (intake, compression, power, and exhaust) to complete one operating cycle. The piston makes two complete passes in the cylinder to complete.

4. DESIGN CONCEPT

4.1.CAD/CAE

Computer aided design or CAD has very broad meaning and can be defined as the use of computers in the creation, modification, analysis and optimization of a design. CAE (Computer Aided Engineering) refers to computers in engineering analysis like stress/strain, heat transfer, and flow analysis. CAD/CAE has been said to have more potential to radically increase productivity than any development since electricity. CAD/CAE builds quality from concept to final product. Instead of bringing in quality control during the final inspection, it helps to develop a process in which quality is there through the life cycle of the product. CAD/CAE can eliminate the need for prototypes. But it required prototypes can be used to confirm rather predict performance and other characteristics. CAD/CAE is employed in numerous industries like manufacturing, automotive, aerospace, casting, mold making, plastic, electronics and other general-purpose industries. CAD/CAE systems can be broadly divided into low end, mid end and high-end systems. Low-end systems are those systems which do only 2D modelling and with only little 3D modelling capabilities. According to industry static's 70-80% of all mechanical designers still use 2D CAD applications. This may be mainly due to the high cost of high-end systems and a lack of expertise. Mid-end systems are actually similar high-end systems with all their design capabilities with the difference that they are offered at much lower prices. 3D sold modelling on the PC is burgeoning because of many reasons like affordable and powerful hardware, strong sound software that offers windows case of use shortened design and production cycles and smooth integration with downstream application. More and more designers and engineers are shifting to mid end system. High-end CAD/CAE software's are for the complete modelling, analysis and manufacturing of products. High-end systems can be visualized as the brain of concurrent engineering. The design and development of products, which took years in the past to complete, are now made in days with the help of high-end CAD/CAE systems and concurrent engineering.

4.2. Modelling

The Model is a Representation of an object, a system, or an idea in some form other than that of the entity itself. Modeling is the process of producing a model; a model is a representation of the construction and working of some system of interest as shown in Figure 3.. A model is similar to but simpler than the system it represents. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On the one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious trade-off between realism and simplicity. Simulation practitioners recommend increasing the complexity of a model iteratively. An important issue in modelling is model validity. Model validation techniques include simulating the model under known input conditions and comparing model output with system output. Generally, a model intended for a simulation study is a mathematical model developed with the help of simulation software. The Figure 4 shows the Ethanol powered 4 stroke 2 wheeler vehicle with front wheel electric drive.

4.3. Software for modelling

a) Solid works,
b) Creo,
c) CATIA,
d) Unigraphics, etc.

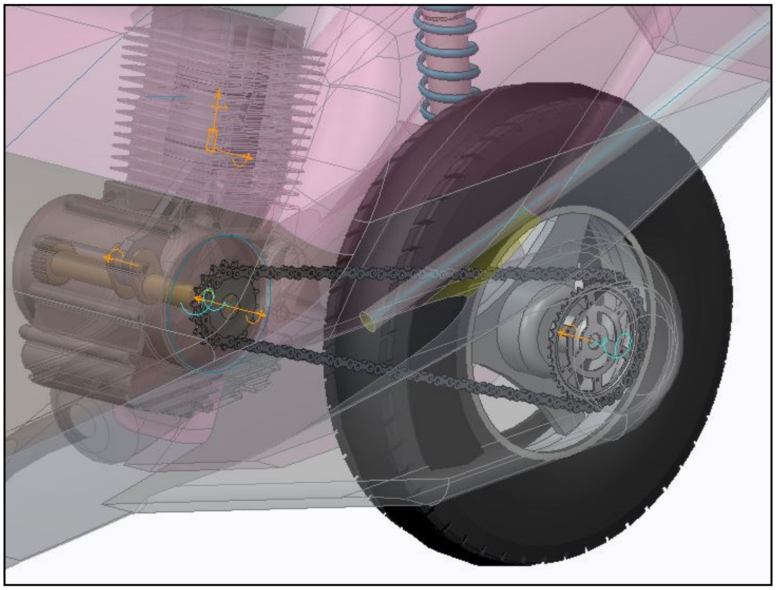

Figure 3.Software modelled object

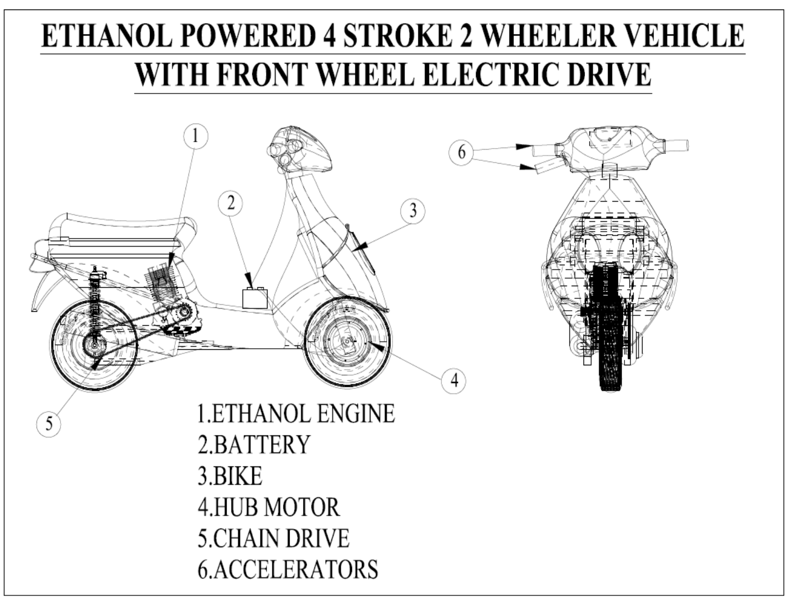

Figure 4.Ethanol powered 4 stroke 2 wheeler

5. ADVANTAGES AND DISADVANTAGES

5.1. Advantages

a) Unlike petroleum, ethanol is a renewable resource.
b) Ethanol burns cleaner in air than petroleum, producing less carbon (soot) and carbon monoxide.

c) The use of ethanol as opposed to petroleum could reduce carbon dioxide emissions, provided that a renewable energy resource was used to produce crops required to obtain ethanol and to distill fermented ethanol.

5.2. Disadvantages

a) Ethanol has a lower heat of combustion (per mole, per unit of volume, and per unit of mass) that petroleum.
b) Large amounts of arable land are required to produce the crops required to obtain ethanol, leading to problems such as soil erosion, deforestation, fertilizer run-off and salinity.
c) Major environmental problems would arise out of the disposal of waste fermentation liquors.
d) Typical current engines would require modification to use high concentrations of ethanol

6. APPLICATIONS

These types of ethanol powered four stroke two wheeler vehicle with front wheel electric drive have a wide range of applications in the fields like,

a) Automobile application
b) Two-wheeler Application
c) Four-wheeler Applications

CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while making this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries. We are proud that we have completed the work with the limited time successfully. The **Design and Fabrication of Ethanol Powered Four Stroke Two-Wheeled Vehicle with Front Wheel Electric Drive** is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done with to our ability and skill, making maximum use of available facilities. Thus, we have developed an**"Ethanol Powered Four Stroke Two-Wheeled Vehicle with Front Wheel Electric Drive** "which helps to achieve low cost automation project which helps to clean the floor automatic with very less amount of manual effort. By using more techniques, they can be modified and developed according to the applications

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