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Semi-annual Progress Report

on

The Electric Moped

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MASTER

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Project Progress Report

Progress Towards Objectives

The overall feasibility studies for both battery powered moped designs are complete.

Moped model #1 operates on a 12 volt electrical system. It uses a one horsepower, permanent magnet, DC motor and a 12 volt, 105 amp-hour, deep-discharge, lead-acid battery. The battery is mounted between the front and rear wheels. It is in front of the seat and in the position normally occupied by the gas tank in a gasoline powered motorcycle. The motor is mounted transversely and is below the battery. It uses the existing engine mount support brackets on the moped frame. The single speed transmission uses a V-belt primary drive and a chain final drive. The vehicle is geared to achieve a top speed of 22 miles per hour. A transistorized speed control is used. The vehicle has an estimated empty weight of 170 to 180 pounds and a gross weight of 350 pounds. Based upon motor and battery specifications, this vehicle has a full-charge range in excess of 25 miles. Maximum range is obtained when the vehicle is traveling at low-to-moderate speeds and is not operating continuously. Other calculations indicate that this moped will maintain a speed of 12 miles per hour for at least 18 miles of continuous use.

Moped model #2 is designed for a 24 volt electrical system. It uses a $1\frac{1}{4}$ horsepower, PM, DC motor and two 34 amp-hour, deep-discharge batteries. The batteries are located in front of the seat in the position normally occupied by the gas tank in a gasoline powered motorcycle. The motor is mounted transversely and is positioned below the batteries. It also uses the existing engine mount support brackets on the moped frame. This vehicle uses the same transmission type as moped #1 to achieve a top speed of 22 miles per hour. It uses a transistorized speed control. It has an empty weight of 165 pounds. Motor and battery specifications indicate that at a steady speed of 12 miles per hour, this moped has a range of at least nine miles before a reduction in speed occurs.

For the 12 volt vehicle, the transistorized speed control is mounted above the motor and in front of the battery. The motor circuit solenoid is located between the battery and the motor. The speed control potentiometer is attached to the motor mount bracket behind the motor. The 24 volt moped has a similar design.

Since the motor on the 12 volt moped is mounted sideways on the frame and is wider than the gasoline engine it replaces, the width of the moped near the motor and transmission area is increased. The spacing between the right and left foot pedals is also increased to allow for

the added width of the drive system. The same is true for the 24 volt moped. Tests have shown that the new pedal positions are not uncomfortable and result in little or no increased feelings of instability.

In order to minimize the increase in width of the spacing between the two foot pedals, the 12 volt motor is mounted to the right of the center line of the moped. This position also improves the side-to-side balance of the moped since the motor drive components are on the left side of the vehicle. The 24 volt motor uses a similar mounting position.

For the proper overall transmission drive ratio, a take-up pulley with a diameter smaller than the diameter of the take-up pulley for the gasoline powered moped (Batavus) is used. The Batavus pulley, however, has the final drive sprocket attached to it, has the correct size bushing to mount on the pedal crank shaft, and is light in weight. For these three reasons, the Batavus pulley is still being used and the new, smaller take-up pulley is attached to it. In order to distribute the drive loads evenly on the Batavus take-up pulley and on the pedal crank shaft, a second Batavus take-up pulley is also used. It is attached to the other side of the smaller take-up pulley.

The rider's seat on the 12 volt vehicle is shifted to the rear by $1\frac{1}{2}$ inches to leave enough room in the front for the 105 amp-hour battery.

To ride one of these mopeds, the operator first raises the kick stand and sits comfortably on the seat. At least one foot still touches the ground. The power switch is turned on with the right hand. This switch is located on the handlebar. The headlamp and taillight switch is also turned on. It is located on the left handlebar. By twisting the twist-grip throttle control from the spring-loaded "off" position with the right hand, the motor circuit is energized by the motor circuit solenoid. The speed of the moped is determined by the position of the twist-grip throttle. The front brake control is operated by the right hand. When this control is used, it tends to cause the hand to twist the twist-grip throttle to the "off" position. The rear brake control is operated by the left hand. The foot pedals are connected to the rear wheel and can be used by the rider to assist the motor when starting the vehicle from a stop, when climbing a steep hill, or when the vehicle has lost motor power for some reason. The foot pedals can be used at any time just as they are used on a bicycle. Under normal conditions, however, pedal assist is not needed. Since the pedals are movable, care must be

taken to make sure the pedals do not touch the road surface when making turns. To start the vehicle in motion, the twist-grip throttle is turned. The rider's feet are positioned on the pedals soon after the moped starts to move.

After the moped has been ridden for a considerable distance, the battery source needs to be recharged. The maximum battery recharge time is normally less than ten hours. The typical recharge time is within the range of four to six hours. The battery charger is a separate unit and is not a part of the moped.

The batteries contain acid. To avoid acid spills, the mopeds should not be tipped. Care must be taken to avoid acid contact with skin and clothing. The affected areas should be washed immediately with water. A physician should be notified in the event of severe skin burns. An emergency water bottle is located under the seat of the moped. Eye protection should always be worn when working with a battery and when riding the moped.

Weight and balance calculations have indicated that the placement of one or more batteries behind the rider or on either side of the rear wheel will result in unstable or out-of-balance configurations.

Status of Work

The following parts have been purchased and received:

QUANTITY	ITEM
2	Batavus mopeds
1	12 volt speed control
1	24 volt speed control
1	24 volt, 1 $\frac{1}{4}$ horsepower motor
3	10 amp battery chargers
2	drive pulleys
2	V-belts
2	take-up pulleys
2	extra Batavus take-up pulleys
1	speed control mount (2 required)
1	speed control actuator (2 required)
2	solenoid microswitches
1	105 amp-hour battery
1	105 amp-hour battery case
2	80 amp-hour batteries
2	80 amp-hour battery cases
2	80 amp-hour battery hold-downs

The following part has been purchased but not received:

QUANTITY	ITEM
1	12 volt, 1 horsepower motor (delivery expected 1-15-80)

The following parts have not yet been purchased:

QUANTITY	ITEM
2	100 amp solenoids
2	34 amp-hour batteries
2	34 amp-hour battery covers

The following parts have been designed but not yet made:

QUANTITY	ITEM
1	12 volt motor mount
1	24 volt motor mount
1	speed control actuator
1	105 amp-hour battery mount
1	105 amp-hour battery hold-down
1	speed control mount
2	pedal crank shafts
4	pulley spacers
2	pedal drive sprocket holders
2	right side covers
2	left side covers

The following parts have not yet been designed:

QUANTITY	ITEM
2	throttle spring return mechanisms
1	34 amp-hour battery mount
2	34 amp-hour battery hold-downs

Other work that still needs to be done includes the modification of the 6 volt lighting systems to operate from the 12 volt batteries. Some of the new metal parts need to be painted.

Description of Parts Designed

The motor mount is used to attach the motor to the engine mount support brackets on the moped frame. The engine mount support brackets permit adjustments in the position of the motor. The speed control potentiometer is attached to the motor mount. The speed control actuator is a small disk mounted on the potentiometer. It connects the potentiometer to the throttle cable. A detent position on the actuator allows the contacts of the solenoid microswitch to open when the throttle twist-grip is in the "off" position.

The battery mount provides a surface on which the battery rests. It is attached to the main tubular frame of the moped. The battery hold-down is used to securely attach the battery to the battery mount. The battery cover encloses the battery and the battery hold-down.

The speed control mount is a C shaped bracket which allows the speed control box to be fastened to the main frame.

The pedal crank shaft is the shaft on which the foot pedals are attached and to which the pedal drive sprocket is mounted. In addition, this shaft acts as the jackshaft for the motor drive. The take-up pulley and drive gear arrangement ride on this shaft. The electric moped uses a

longer shaft than the one supplied by the moped frame manufacturer. The pulley spacers are large rings which allow the smaller take-up pulley to be attached to the two Batavus take-up pulleys and drive gear. The pedal drive sprocket holder fastens the pedal drive sprocket to the pedal crank shaft.

The right side cover encloses the right side of the motor and pedal area to keep the rider away from the moving parts. The left side cover protects the rider from the moving parts on the left side of the bike.

The throttle spring return mechanism forces the throttle to return to the "off" position when the rider's hand is removed from the twist-grip handle.

Design Problems

The 24 volt moped model probably will not achieve a 25 mile range. This is because suitable batteries with a 50 to 60 amp-hour rating have not been found. The two 80 amp-hour batteries originally purchased for the 24 volt moped, if used together, would produce a vehicle which would exceed weight limitations. Therefore, two 34 amp-hour batteries are used.

The use of three 34 amp-hour batteries to produce a 36 volt system appears to be a suitable design configuration.

if the batteries are mounted between the front and rear wheels. This design will not be tested.

The two 80 amp-hour batteries can be used as direct replacements for the 105 amp-hour battery in the 12 volt moped.

Changes in Cost

There have been no significant changes in cost.

Changes in Schedule

A few changes in the proposed schedule have been made. The design phase should be completed by 1-15-80. This is in month seven of the grant period.

The assembly of vehicle #1 should be completed by 3-15-80. The assembly of vehicle #2 should be completed by 4-15-80.

Vehicle testing and modification will occur in month 11. The testing program is set up to check the endurance of the mopeds. These vehicles will be ridden as many miles as practical. The performance characteristics will be measured. The vehicles will be tested for speed, acceleration, braking, and range. The range test will be performed at various speeds.

The user evaluation program will take place in months 12 through 16. (June 1980 - October 1980) It is in this program that the public will be allowed to borrow these mopeds for several hours at a time in order that their comments and suggestions can be obtained.

The demonstration program will take place in months 13 through 18. In this program, the vehicles will be displayed at regional fairs and expositions, vehicle trade shows, shopping malls, and other public areas. The events of the demonstration program will be coordinated with the user evaluation program.

This schedule is set up to allow for a complete summer period of testing and evaluation.