

**COLUMBIA** ®  
Columbia ParCar Corp.

## SERVICE MANUAL

CR-10 Chariot

5/2011

 Columbia / ParCar OEM Parts  
[evtechnicalservices.com](http://evtechnicalservices.com)

## FOREWORD

This service manual has been prepared with two purposes in mind. First, it will introduce the trained maintenance professional to the latest field-tested and factory approved major repair methods. Secondly, it will acquaint the reader with the construction of Columbia Industrial Commercial vehicles and assist him/her in performing basic maintenance and repair. We sincerely believe that this manual will make your association with Columbia Industrial Commercial vehicles more pleasant and profitable.

In addition to the information given in this Service Manual, Service Bulletins are issued to Columbia Industrial Commercial Vehicle Dealers, from time to time, which cover interim engineering changes and supplementary information. Service Bulletins should be consulted for complete information on the models covered by this manual.

To ensure the safety of those servicing Columbia Industrial Commercial vehicles and to protect the vehicles from possible damage resulting from improper service or maintenance, the procedures followed in this manual should always be followed exactly as outlined. Execution of the procedures and troubleshooting tips as outlined will ensure the best possible service from the vehicle(s). To reduce the chance of personal injury and/or property damage, carefully observe NOTICES, CAUTIONS, WARNINGS and DANGER recommendations throughout this manual. See Chapter 1 for additional details.

### Preparation For Service

Proper preparation is very important for efficient service work. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible and reduce the incidence of misplaced tools and parts. Columbia Industrial Commercial vehicles that are excessively dirty should be cleaned before work begins. Cleaning will occasionally uncover trouble sources. Tools, instruments and parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a needless delay. Special tools required for a job are listed at the front of each section.

### Model Identification

Always, give the full vehicle identification number when ordering parts or making inquiries about your Columbia Industrial Commercial vehicle.

Use of the full and complete vehicle identification number (VIN) information will assure your dealer or service provider is supplying you with the correct parts for your vehicle. See Chapter 2 for vehicle identification information.

### Use Genuine Replacement Parts

#### **⚠ WARNING**

**When replacement parts are required, use only genuine Columbia Industrial Commercial Vehicle parts or parts with equivalent characteristics including type, strength and material. Failure to do so may result in product malfunction and possible injury to the operator and/or passenger.**

To ensure a satisfactory and lasting repair job, follow the service manual instructions carefully and use only genuine Columbia Industrial Commercial Vehicle replacement parts. This is your insurance that the parts you are using will fit right, operate properly and last longer. When you use genuine Columbia Industrial Commercial Vehicle parts, you use the best.

### Product References

When reference is made in this manual to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be used in place of the one mentioned.

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## 1.0 SAFETY

### 1.1 OVERVIEW

Statements in this manual preceded by the words **DANGER, WARNING, CAUTION or NOTICE** and words printed in **bold face** are very important. We recommend you take special notice of these items.

It is important to note that some warnings against the use of specific service methods, which could damage the vehicle or render it unsafe, are stated in this service manual. However, please remember that these warnings are not all inclusive. Since Columbia ParCar Corporation could not possibly know, evaluate and advise servicing personnel of all possible ways in which service might be done or of the possible hazardous consequences of each way, we have not undertaken any such broad evaluation.

Accordingly, anyone who uses a service procedure or tool which is not recommended by Columbia ParCar must first thoroughly satisfy him/herself that neither their nor the operator's safety will be jeopardized by the service methods selected.

### 1.2 SYMBOLS IN PROCEDURES

#### **⚠ DANGER**

**Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

#### **⚠ WARNING**

**Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

#### **⚠ CAUTION**

**Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**

**NOTICE:** Notices are messages not related to personal injury. They will provide key information to prevent property damage and to assure procedures are more easily understood or implemented.

### 1.3 SAFETY INFORMATION

It is Columbia ParCar's specific recommendation that the following safety information must be observed at all times. Not all are repeated throughout this manual, but the recommendations included must be observed whenever these subjects are encountered.

#### **⚠ DANGER**

**Any modifications or changes to the vehicle that affect the stability or increases vehicle speed beyond factory specifications could result in severe personal injury or death.**

**Always, remove keys and disconnect the batteries before servicing or repairing your vehicle.**

**All batteries used in electric vehicles can explode! Always wear full face shield when working on or near batteries. Hydrogen fumes are a natural byproduct of charging and discharging and are extremely explosive. Do not smoke around electric vehicle batteries. Keep sparks and flames away from batteries. Battery charging should only be done in a well-ventilated area. See *Section 8-Batteries*, for specific details.**

**When working around batteries, use approved insulated tools, remove jewelry such as rings, watches, chains, etc. and place an insulating material such as wood, plastic, rubber, etc. over batteries covering all connections.**

**⚠ DANGER**

Batteries contain acid which can cause severe burns. Avoid contact with skin, eyes, or clothing. Wear full face shield and rubber gloves when working on or near batteries.

**ANTIDOTES:**

- External: Flush with water. Call a physician immediately.
- Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil.
- Eyes: Flush with water for fifteen minutes. Call a physician immediately.

If any problems are found during scheduled maintenance or inspections, Do not operate vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury or death.

**⚠ WARNING**

Only trained maintenance professionals should repair or service this vehicle. Persons doing even simple repairs or service should have working knowledge and experience in general electrical and mechanical repair. Follow all procedures exactly and observe all warnings stated in this manual. Use caution and common sense.

Proper service and repair is important for safe, reliable operation of all Columbia Industrial/Commercial vehicles. The service procedures recommended and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for this purpose. These special tools should be used when and as recommended.

Moving parts hazard! When operating any vehicle in a stationary position, avoid chains, belts, and wheels which could snag clothing or cause severe injury to body parts. A running vehicle must be worked on with the greatest care. Use caution and common sense.

Working on Columbia ParCar vehicles without following proper procedures and using proper lifting equipment may result in vehicle damage or personal injury. See *Section 3 -Lifting Instructions* detailed instructions.

Always wear safety glasses or approved eye protection while servicing vehicle.

Failure to maintain vehicle properly could result in decreased vehicle performance, reliability or cause severe personal injury.

The modification of vehicles for use in other than its intended purpose is not recommended. Any unauthorized modification may void your vehicle warranty.

**HOT! DO NOT** attempt to service hot electric motor or resistors. Failure to observe this warning could result in severe burns.

**⚠ CAUTION**

Check the vehicle for proper location and condition of all vehicle safety and operation decals. Refer to page2-2 for locations.

Exceeding rated vehicle load capacities could result in possible severe injury or property damage.

Properly dispose of the battery.

## 1.4 SAFETY CONCERNS

It is recommended that the operator, owner or renter of this vehicle comply with the OSHA requirements as stated in the Code of Federal Regulations, Section 29, 1910.178, Powered Industrial Truck Training Standard and the ANSI requirements as stated in Personnel and Burden Carriers ANSI B56.8.

As a minimum every operator should, in addition to the above requirements found in the standards noted above:

- Demonstrate a working knowledge of each control.
- Understand all safety rules and guidelines as presented in this manual.
- Know how to properly load and unload cargo.
- Know how to properly park the vehicle.
- Recognize an improperly maintained vehicle.
- Demonstrate ability to handle the vehicle in all conditions.

Every operator, owner or renter of this vehicle must, at a minimum:

- Define where the vehicles should and should not be driven and utilized.
- Ensure all proper warnings as to driving hazards are properly displayed and visible.
- Install safety signage concerning hills, speed bumps, ramps, turns, blind crossings, intersections, etc.
- Define who should and who should not drive the vehicles.
- Enforce safe driving and operating rules.
- Provide driver training for first time operators and review safe operating recommendations regularly.
- Maintain vehicles in a safe operating condition and maintain a schedule for daily, weekly, monthly, quarterly, semi-annually and annual vehicle inspections.
- Determine who, when, and how should pre-operation inspections be conducted.
- Notify operators what should be done if an unsafe condition or operating problem is discovered.

## 1.5 LIFTING INSTRUCTIONS

### **⚠ WARNING**

**Use extreme caution lifting or working on or around lifted vehicle. Vehicle should be on a flat, hard and level surface.**

When lifting the vehicle for service, remove key and use a sturdy lifting device such as a hoist or floor jack placed under the Chariot body. Always block wheels to prevent it from rolling. After the body is lifted 4 to 6 inches from the floor, place a suitable device under vehicle frame to support vehicle weight. An example is a 4" x 6" wooden block.

### **⚠ CAUTION**

**If vehicle is raised while loaded, check that the load is secured before lifting. Failure to do so could cause damage to the vehicle, the load or cause personal injury.**

## 2.0 GENERAL INFORMATION

### 2.1 VEHICLE DESCRIPTION

The Chariot is a single passenger vehicle involving stand-up operation. This vehicle is designed to be driven on smooth surfaces in and around industrial plants, nurseries, institutions, motels, mobile home parks, and resorts.

This vehicle is not designed to be driven on public highways. It is designed to conform to requirements for Type E vehicles as described in O.S.H.A. Standard Section 1910.178 (Powered Industrial Trucks) and with all applicable portions of the American National Standard for Personnel and Burden Carriers (ANSI B56.8 1993 Part III).

### 2.2 VEHICLE IDENTIFICATION NUMBER (VIN)

Each vehicle is assigned a unique Vehicle Identification Number (VIN). The VIN describes facts and features of the vehicle and contains thirteen (13) digits. The VIN can be found in two locations.

The VIN is recorded on the vehicle nameplate which is located on the left side of the operator's position. See Figure 1.3.1.

The nameplate also has other important information such as vehicle weights and capacity. Do not exceed this capacity. This rated capacity includes cargo and operator.



Figure 2.2.1

The VIN is also stamped on the metal cross bar located under the foot treadle platform. See Figure 1.3.2.



Figure 2.2.2

To ensure prompt service when repairs or adjustments are required, your Columbia Dealer must have the VIN.

**CR1A1-0ZJ1234** is an example of a current VIN.

### 2.3 VIN MATRIX

#### 13 DIGIT VIN

Digit 1 thru 3 = Abbreviation (Model)	CR1 (CR-10 Chariot)
Digit 4 = Power System	A = Series, Resistor
Digit 5 = System Voltage	1 = 12V
Digit 6 = VIN Spacer	- = normal
	# = Special Product
Digit 7= Controller Amperage	0 = Not Applicable
Digit 8 = Axle/Brake System	Z = Rear Mechanical
Digit 9 = Build Year	H = 2009, J = 2010, K = 2011 etc.
Digit 10 Thru 13 – Build Sequence	1234

## 2.4 VEHICLE SPECIFICATIONS

Passenger Capacity	1
Max. Speed (MPH)	9
Turning – Curb to Curb (in)	79
Turning –Intersecting Aisle (in)	41
Overall Length (in)	52
Overall Width (in)	29.5
Overall Height (in)	44
Wheelbase (in)	36
Load Bed Height (in)	24
Load Bed – LxW (in)	18x16

## 2.5 VEHICLE CONTROLS

This section describes the operating controls of the vehicle. Figure 2.5.1 identifies the locations of many of these controls.

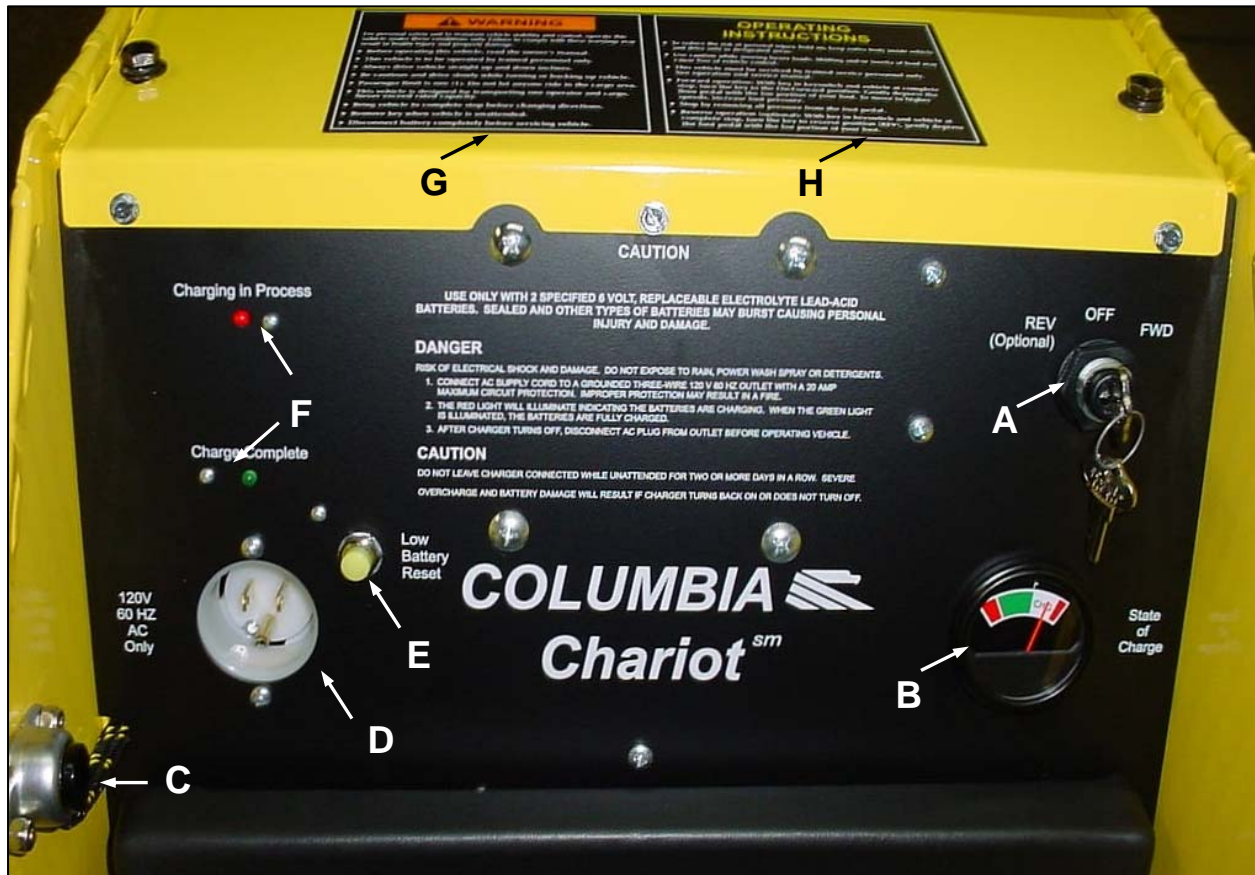


Figure 2.5.1

### 2.5.1 KEYSWITCH – Fig. 2.5.1 A

The keyswitch energizes the vehicle. Rotate the key to the right from vertical to turn the vehicle on, return to vertical to turn the vehicle off.

If equipped, the keyswitch can also have a reverse direction. Rotate the key to the left from vertical to move in reverse (REV).



**NOTICE: Do not shift from forward to reverse or vice-versa while the vehicle is in motion. Make sure the vehicle is completely stopped before changing direction.**

**CAUTION**

**To avoid injury, speed in reverse should always be kept at a minimum.**

The keyswitch should be in the vertical OFF position whenever the operator leaves the vehicle. The switch is also designed to secure and disable the vehicle. You can remove the key only when the key switch is in the OFF position.

**2.5.2 BATTERY STATE OF CHARGE METER – Fig. 2.5.1 B**

The battery state of charge meter is an analog gauge with an indicating needle and a colored background. It is a continuously reading meter. At rest with fully charged batteries the meter should read in the right white region. When accelerating quickly, the needle will move to the left green region near the very far left red region. This is normal. If the needle continues past the green region into the very far left red region, it indicates that the batteries need recharging as soon as possible to avoid a shut-down of the vehicle.

**2.5.3 HORN BUTTON – Fig. 2.5.1 C**

The horn button is located on the left inside body panel and may be sounded by applying lateral pressure with the operator's left leg.

**2.5.4 CHARGER RECEPTACLE – Fig. 2.5.1 D**

The charger receptacle is for battery charging using the supplied AC cord.

**2.5.5 LOW BATTERY RESET SWITCH – Fig. 2.5.1 E**

The Low Battery Reset Switch is used if the battery is heavily over discharged. See Section 3.8.

**2.5.6 CHARGING STATUS LIGHTS– Fig. 2.5.1 F**

These lights indicate the battery charging status.

**2.5.7 WARNING LABEL and OPERATING INSTRUCTION - Fig. 2.5.1 G & H**

Read the warning label and operating instruction information carefully before operating the vehicle.

**CAUTION**

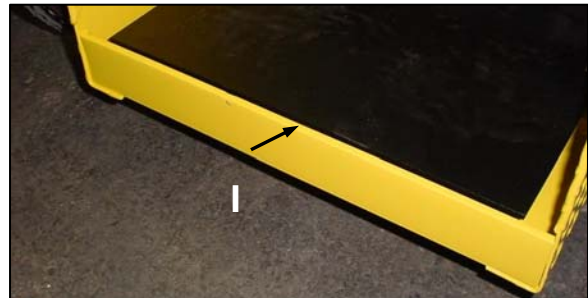
**Do not remove any nameplate, warnings, or instructions affixed to your Columbia Vehicle. Promptly replace any that become damaged or removed. Contact Columbia ParCar for replacements.**

**2.5.8 FOOT TREADLE PLATFORM – Fig. 2.5.2 I**

The foot treadle platform controls acceleration and braking. By slowly tilting the treadle forward (weight on toes) the accelerator is engaged and vehicle moves forward. By tilting the treadle backward (weight on heels) the brake is applied.

**NOTICE: Do not stomp down on the rear of treadle.**

The parking brake is spring loaded to set automatically when leaving the vehicle and is automatically disengaged by tilting the treadle forward.



**Figure 2.5.2**

## 2.5.9 STEERING HANDLE BARS – NOT SHOWN

The steering system is designed to operate as a bicycle does. The vehicle will turn to the same direction as the handle bar.

### ⚠ WARNING

**Be sure to have both hands on the handlebars at all times.**

**Do not turn the vehicle sharply at high speeds.**

## 2.6 DRIVING THE VEHICLE

- Do not operate vehicle unless you are a qualified and trained operator.
- Keep the vehicle under control at all times.
- Drive only on level surfaces or on surfaces having an incline of no more than 10%.
- Drive slowly when making a turn, especially if the ground is wet, slippery or when driving on an incline.
- Do not drive this vehicle in hazardous areas unless this vehicle is approved and labeled for such operation.
- Do not drive over loose objects, holes or bumps.
- Observe all traffic regulations and speed limits.
- Keep to the right of traffic under normal conditions.
- Maintain a safe distance from all objects and other vehicles.
- Yield right of way to pedestrians, ambulances, fire trucks or other vehicles in emergencies.
- Do not overtake another vehicle at intersections, blind spots or other dangerous locations.
- Keep a clear view ahead at all times. Slow and sound the horn when approaching a corner or other blind intersection.
- Immediately report any accident or vehicle problem to your supervisor.
- Do not load cargo that can easily fall off this vehicle.
- Do not exceed the cargo load capacity of this vehicle.

## 2.7 PRE-OPERATION CHECKLIST

### ⚠ CAUTION

**Before operating the vehicle always inspect the items listed in the following checklist. Should any item malfunction or need adjustment. Do not operate vehicle until the problem has been corrected.**

ITEM	PROCEDURE
Batteries	Fully charged or adequately charged to provide power for duration of operations.
	The AC cord is disconnected from the vehicle.
	Electrolyte level in each cell covers the top of cell plates.
	Batteries are secure and free of corrosion. All terminals and connections are tight.
Tire Pressure	Inflated to the specifications labeled on the tire sidewall.
Horn	Press horn button to sound horn.
Treadle	Operates smoothly
Labels	All warning and operation labels in place.
Steering	Responsiveness and the absence of excessive free play.
Cargo	Secured to the bed platform.
	Load is balanced and not top heavy.
Obstacles	Path of intended travel is free for obstructions.

## 2.8 PARKING

- If you will be away from this vehicle turn off the keyswitch, remove the key and take the key with you.
- If you park this vehicle on an incline, block the wheels.
- Do not block fire aisles, fire equipment, or stairways.

## 3 ELECTRIC SYSTEM

### 3.1 IMPORTANT INFORMATION

The type of battery used in a Columbia vehicle has a service requirement which is quite different from that of an automotive battery.

The electric vehicle battery supplies all of the power to drive the vehicle. During operation the power stored in the batteries is expended. While the amperage drain rate can vary greatly depending on the type of service, the duration of use and the number of "starts" and "stops" made during a day, the batteries nevertheless progress through each duty cycle from "fully charged" to an almost depleted state. This type of service is known as "deep cycle" service and electric vehicle batteries are specifically designed to handle this type of service.

Proper performance of your Columbia Vehicle can only be obtained from specified deep cycle, electric vehicle batteries.

**PLEASE REVIEW IMPORTANT DANGER STATEMENTS WHEN WORKING AROUND BATTERIES AND CHARGING SYSTEMS!**

#### **⚠ DANGER**

**Always remove key and disconnect batteries before servicing or repairing the vehicle.**

**Always wear full-face shield when working on or near batteries.**

**All batteries used in electric vehicles can explode! Batteries produce explosive hydrogen gas at all times, especially, during charging or discharging. Ventilate area when charging batteries.**

**Do not attempt to charge a battery if it is frozen, or if the case is bulged excessively. Frozen batteries can explode!**

**Do not smoke around batteries. Keep sparks and flames away from batteries and the charging area.**

**When working around or servicing batteries use care to prevent an accidental arc which could cause an explosion.**

**Use only approved insulated tools, remove jewelry such as rings, watches, chains etc. and place an insulating material (wood, plastic, rubber etc.) over all battery connections.**

**If any problems are found during scheduled maintenance or inspections, do not operate vehicle until repairs are made.**

**Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.**

**Battery acid is poisonous and can cause severe burns. Avoid contact with skin, eyes, or clothing.**

#### **ANTIDOTES**

**EXTERNAL: Flush with water. Call a physician immediately.**

**INTERNAL: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately**

**EYES: Flush with water for fifteen minutes. Call physician immediately.**

**NOTICE:** Automotive batteries should never be used for "deep cycle" application, as their useful life will be very short.

Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical/electronic components in the charger and vehicle from all but direct or "close proximity" lightning strikes.

Damaged or corroded battery terminals should be replaced or cleaned as necessary. Failure to do so may cause overheating during operation.

Do not attempt to recharge batteries with a charger not designed for your vehicle.

Only trained technicians should service the CR-10 charger.

### 3.2 BATTERY DISCONNECT METHODS

Figure 3.2.1 illustrates the battery configuration. Disconnect both leads before performing any maintenance.



Figure 3.2.1

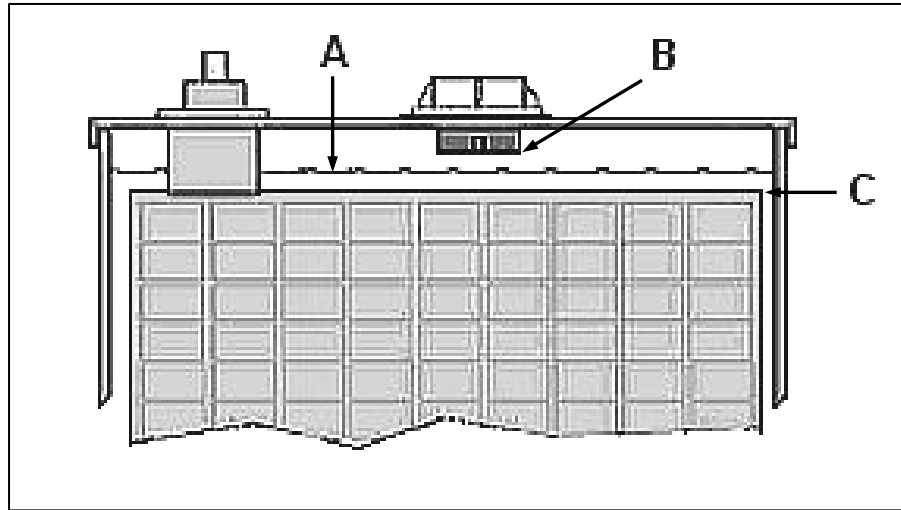
### 3.3 BATTERY REMOVAL AND INSTALLATION

- Remove battery negative (-) cable.
- Remove battery positive (+) cable.
- Remove battery hold down.
- Remove batteries from vehicle.
- To install batteries, reverse the removal procedure with the negative (-) cable being attached last.

### 3.4 BATTERY INSPECTION AND MAINTENANCE

Check the electrolyte level on new batteries before they are put into service, and, at a minimum, once a week thereafter. Water use increases as batteries age.

See Figure 3.4.1. Never allow the electrolyte level (A) to fall below the top of the plates (C). If the plates are exposed, add only enough to cover the plates before charging. After batteries are fully charged, fill cells to just below the bottom of the cell vents (B). Electrolyte level should not touch the bottom of the cell vents.



**Figure 3.4.1**

Do not overfill batteries. Electrolyte expands and can overflow during charging. Water added to replace the spillage dilutes the electrolyte and reduces its specific gravity.

Use only distilled water. Vehicle batteries may use up to 16 quarts of water during their useful life and non-distilled water may contain harmful minerals which will have a cumulative adverse effect on battery performance and life.

Batteries and connections must be clean and dry.

Be sure battery hold downs are properly tightened. A loose hold down may allow the battery to become damaged from vibration or jarring. A hold down that is too tight may buckle or crack the battery case.

Weekly inspect battery posts, clamps and cables for breakage, loose connections and corrosion. Replace any that are damaged. Check to see that battery cap vent holes are clear. Plugged vent holes will not permit gas to escape from the cell and could result in battery damage.

### **3.5 BATTERY CLEANING**

Acid-soaked dirt on the battery terminal connections causes current leakage, reduces battery efficiency, and battery life.

Check that all vent caps are tightly in place before washing.

Hose wash battery terminal connections periodically with clean low-pressure water to keep them free of acid spillage, dirt, and other debris. Do not hose wash switches, solenoids and other electrical control devices. Cover as necessary to prevent splashing.

Clean battery terminal connections with baking soda (sodium bicarbonate) and water solution (5 teaspoons baking soda per quart water) and stiff bristle brush. Rinse with clean water and dry with a clean cloth. Do not allow solution to enter cap vent holes.

**NOTICE: Follow local ordinances and codes for proper disposal of battery cleaning waste.**

### **3.6 CONDITIONS WHICH AFFECT CHARGING**

Always schedule enough charging time to allow the batteries to become fully charged. Charging time is affected by age and battery condition, state of discharge, electrolyte temperature, AC line voltage, and other variables. Correct charging methods extend battery life and vehicle range between charges.

New batteries need up to four hours more charging than “mature” batteries. Before the first use, completely charge new batteries. Charging time will vary based on conditions noted above but will probably be 6 to 10 hours.

If vehicle is used only occasionally, a refresher charge should be given prior to using.

Battery efficiency is affected by temperature. If the temperature of the outside air and/or batteries is below 60° F, battery capacity is reduced. Batteries will require more frequent and longer charge periods in early spring, fall and winter.

As batteries age, they finish charge at progressively higher charge rates and tend to use more distilled water. At this point in battery age, charger will automatically begin reducing charge time.

Batteries found defective must be replaced. All batteries in a vehicle should be matched according to age, capacity and brand.

### 3.7 CHARGER INFORMATION

The built-in battery charger is custom made for Columbia vehicle CR-10 Models. Its operation is totally automatic. When connected to a 110 - 120 Volt AC power source, the charger's electronic timer will turn the charger on. It determines and provides the energy necessary to return batteries to a fully charged state, automatically shutting off when the batteries are fully charged. This occurs when each cell reaches approximately 2.5 volts.

### 3.8 CHARGER OPERATING INSTRUCTIONS

Plug 120 volt AC supply cord into charger receptacle on charger panel. After a short time delay of approximately 5 to 6 seconds, a RED light comes on indicating battery charging.

When the solid state circuitry senses that the batteries are fully charged, the RED light turns off and the GREEN light turns on indicating that charging is complete.

The GREEN light will remain on until the AC cord is disconnected. At that point the light will turn off and the charger will reset itself for the next charging cycle.

### 3.9 LOW BATTERY RESET SWITCH:

This is used if the batteries are heavily over discharged. When the AC cord is connected, the RED light will turn on but will shortly turn off. To reactivate the charger, push the reset button for 10 seconds. This will restart the charger. Release the button and the charger will continue to charge.

### 3.10 CHARGER TROUBLE SHOOTING CHART

Symptom	Repair or Replace
No transformer hum	AC Fuse
	AC Input Cord
	Loose wires on auto-start control
	Primary of transformer
	Auto-start control
Transformer hums, but no ammeter deflection	DC fuse
	DC connector shorted or open diode
	Defective ammeter
AC fuse keeps blowing	Shorted AC cord
	Shorted primary of transformer
Charger output low or battery not getting charged	Defective capacitor
	Resonant of transformer
	Open diode
Charger not shutting off	Loose wires on auto-start
	Defective auto-start

### 3.11 SPECIFIC GRAVITY TEST

It is possible to determine a battery's ability to perform by measuring the specific gravity (sp. gr.) of each cell with a hydrometer. This is the best method to determine a defective battery.

The hydrometer readings indicate two things:

- State of Charge - The amount of electrical power stored in the battery.
- Condition - The ability of battery to store and deliver power.

**NOTICE: Batteries should be fully charged before performing specific gravity tests to determine battery condition. Hydrometer tests of batteries not fully charged are misleading and inconclusive.**

There are different type hydrometers. Carefully read and follow the instructions supplied with your hydrometer.

### 3.12 TPS FOR PROLONGING BATTERY LIFE

To prolong battery life, recharge batteries as soon as they become 20% or more discharged (less than 1.238 sp. gr.). Batteries may be recharged if vehicle has been driven 15 minutes or more since the previous charge.

Do not allow batteries to fall below 80% discharge (1.098 sp. gr.). Deep discharging significantly reduces battery life. Opportunity charging during breaks or shift change can be used to extend range but always complete a full charge cycle at least once a day.

If the vehicle is not operated daily the Power keyswitch should be turned off. This will reduce power loss on the batteries.

Batteries in storage may self discharge and should be recharged when the specific gravity falls below 1.238 sp. gr.

**NOTICE: Specific gravity readings are at 80°F. Values need adjustment for electrolyte temperature. Reduce .004 for every 10°F below 80°F. Increase by that amount for every 10°F above**



## 4.0 SERVICING

### 4.1 MAINTENANCE GUIDELINES

To ensure that the vehicle is kept in a safe and correct operating condition, it must be inspected and maintained on a regular basis. Proper lubrication, electrical control adjustments, safety feature checks, etc. performed at recommended intervals will help prevent damage or failure of the unit while providing optimum performance.

Follow the guidelines below to assure proper maintenance.

- Allow only trained maintenance personnel to maintain, repair, and inspect the vehicle.
- Before starting any repairs or maintenance, immobilize the vehicle by turning the power keyswitch off and removing the key.
- Disconnect both of the main battery pack leads before working on or disconnecting any electrical component or wire.
- Block the chassis with jack stands before working under a raised vehicle.
- Conduct vehicle performance checks in an authorized area where a safe clearance exists.
- Before starting the vehicle, follow the recommended safety procedures in Chapter 1, (SAFETY).
- Avoid fire hazards and have fire protection equipment present in the work area.
- Do not use flammable fluids for cleaning parts.
- Work in a properly ventilated work area.
- Regularly inspect and maintain in safe working condition the brakes, steering mechanisms, speed and directional control mechanisms, warning devices, guards and safety devices.
- Keep the vehicle in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

### 4.2 BRAKE SYSTEM

The mechanical brakes consist of two rear drum brakes. With no force applied to the treadle, brakes are properly adjusted when the back edge the treadle is approximately even with the top edge of the rear frame crossbar. See Figure 4.2.1.

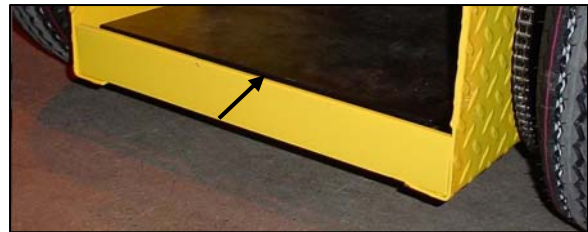


Figure 4.2.1

To adjust the brakes (See Figure 4.2.2):

- Loosen jam nut (A) on upper end of the treadle to brake linkage.
- Turn (lengthen) upper brake linkage (B) and check adjustment.
- Once properly adjusted and tighten the jam nut.

**NOTICE: Minimum brake shoe lining thickness is .080 inches.**

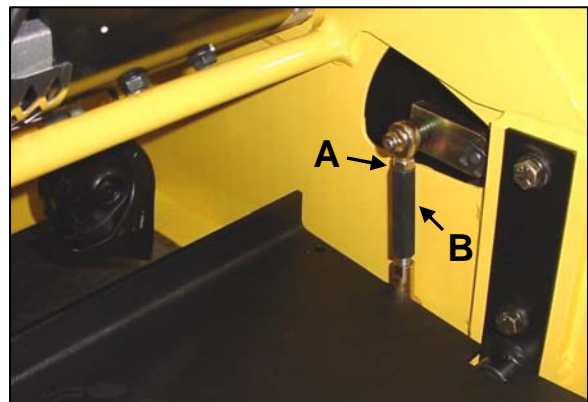


Figure 4.2.2

To remove the brakes (See Figure 4.2.3):

- Raise and block up the rear of the vehicle.
- On the drive wheel side, remove the drive chain master link (A) and the drive chain.
- Remove the four wheel lug nuts holding the rear wheels to the rear hubs and remove the wheels.
- Remove the dust cap.
- Remove the cotter pin and castle nut from the spindle (B).
- Remove the hub (C) from the spindle. On the drive wheel side, it will be necessary to depress the treadle to release the brake before the hub with drum/sprocket assembly can be removed.
- Remove 7/16" nut (D) from the bolt at the upper end of the treadle to brake assembly linkage and disconnect the linkage.
- Undo the springs and move the brake shoes aside allowing access to the backing plate (E) and the backing plate retainer screws (not shown).
- Remove brake backing plate retainer screws and brake backing plate spacer (F).

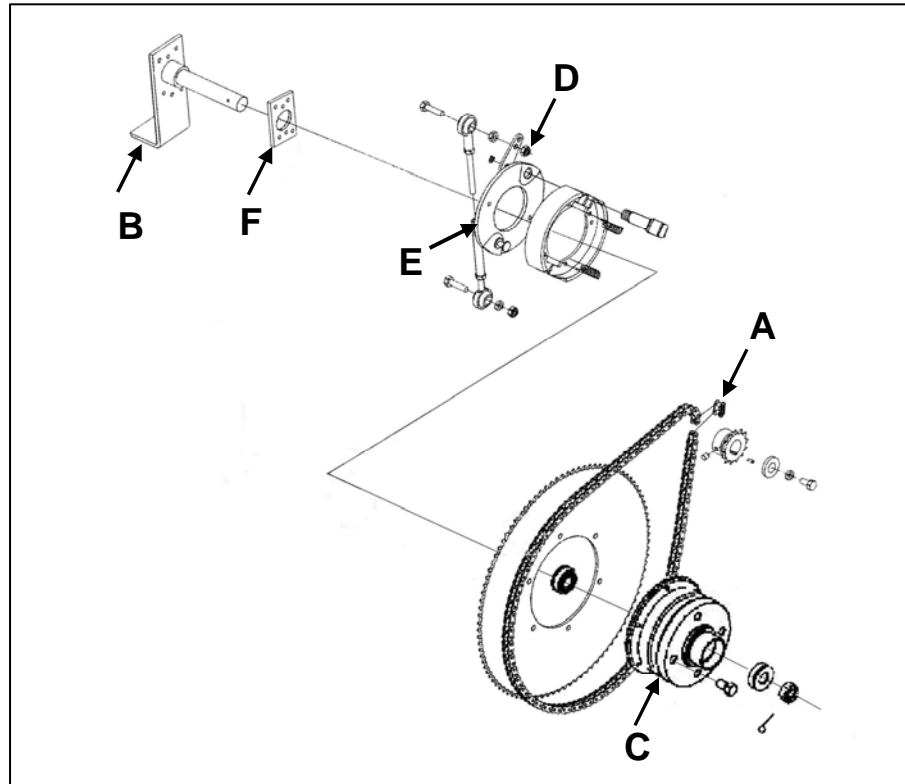


Figure 4.2.3

To install brakes:

- Install the brake backing plate spacer and the brake backing plate. Use a thread-locking compound on the brake backing plate retainer screws and tighten the screws, then loosen each screw 1/4 turn.
- Connect the upper end of the treadle to the brake assembly linkage and torque the nut to 120 inch pounds.
- Temporarily install the brake shoes, hub with drum/sprocket assembly and castle nut on hub.
- Depress rear of treadle to apply the brakes and to center brake assembly on spindle.
- Carefully remove the castle nut, hub with drum/sprocket assembly and brake shoes without moving the brake backing plate.
- Torque the brake backing plate retainer screws to 200 inch pounds.
- Install brake drum sprocket/hub assembly.
- Install the hub on the spindle. On the drive wheel side it will be necessary to depress the treadle before the hub with drum/sprocket assembly can be installed.
- Install the castle nut on the spindle. Torque the castle nut to 120 inch pounds and then back the castle nut off two slots and install the cotter pin.
- Install the dust cap.
- On the drive wheel side, install the drive chain and master link. See Drive Chain Section 4.4 for proper chain adjustment.
- Install the wheels and lug nuts and torque to 65 foot pounds. Tighten lug nuts evenly in a star pattern.

### 4.3 FRONT FORK ASSEMBLY - Figure 4.3.1

To remove fork and handle bar:

- Place the front of the vehicle frame on blocks to allow for wheel removal.
- Remove the handlebar-retaining nut (A) with a 1-1/2" socket.
- Carefully pull the handlebar upward with slight side to side motion to remove the handlebar from the fork spindle.
- Remove the front fork nut (B) with a 1-1/2" socket.
- Pull the fork assembly downward out from the frame.

To install fork and handle bar:

- Slide the front fork up through the frame and bearing assemblies.
- Install and tighten the front fork nut (B) until there is no play felt in the front fork and then tighten the front fork nut an additional 1/8 turn.
- Push the handlebar onto the fork spindle.
- Install the handlebar retainer nut (A), align handle bars to front fork and torque to 200 foot pounds.

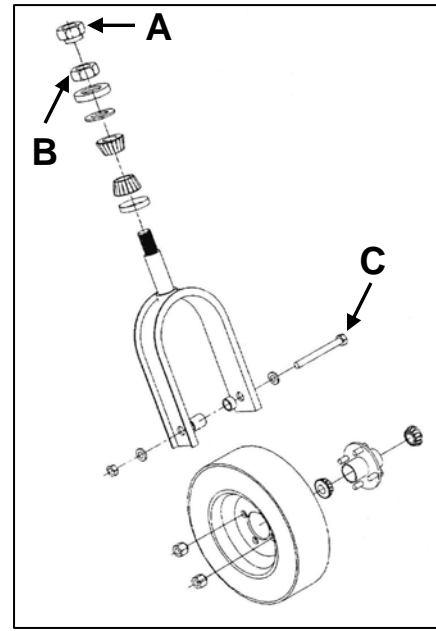


Figure 4.3.1

**NOTICE:** Make sure that the handlebars and front fork spindle are properly aligned

To remove the front wheel & hub:

- Place the front of the vehicle frame on blocks to allow for wheel removal.
- Remove the nut and washer from the front axle (C) and pull the axle from the front fork to remove.
- Remove the four lug nuts from the front hub.

To install the front wheel & hub:

- Install the hub on the front wheel and torque the lug nuts to 35 foot pounds. Tighten lug nuts evenly in a star pattern.
- Insert the front axle through the front fork, wheel spacers and hub.
- Install the washer and nut on the front axle, tighten the axle nut to 120 inch pounds.

### 4.4 DRIVE CHAIN

To removal & install chain:

- See Fig. 4.4.1. On right side of vehicle below kneepad, loosen jam nut (B) and the drive motor adjustment screw (A).
- Loosen the four (4) drive motor mounting bolts (Fig. 4.4.2).
- Rotate drive motor to back.
- Remove drive chain.
- Reverse procedure to install.

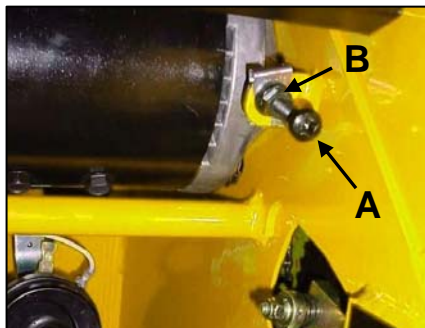


Figure 4.4.1

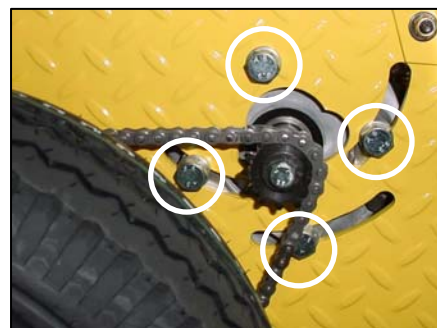


Figure 4.4.2

#### Tension Adjustment:

- Lift the rear of the vehicle and remove the drive wheel.
- Loosen the 4 drive motor mounting bolts (Fig. 4.4.2) and jam nut on the drive motor adjusting screw. Turning motor adjusting screw towards motor will tighten drive chain. Turning adjusting screw away from motor will loosen drive chain. With motor mounting bolts tight, proper chain deflection is no more than 0.50' (1/2 inch). See arrow Fig. 4.4.3.
- Torque motor mounting bolts to 150 inch pounds and tighten the jam nut (Fig. 4.4.1 B) on motor adjusting screw.
- Install drive wheel.

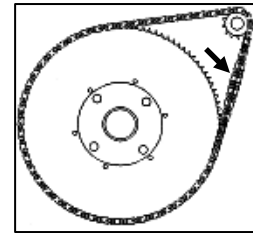


Figure 4.4.3

#### 4.5 DRIVE MOTOR

To remove the drive motor (Figure 4.5.1):

- Remove the charger cover plate.
- Disconnect the wires from the motor, noting their locations for reinstallation.

**NOTICE: To avoid possible internal motor damage when removing or installing cables, use a wrench to hold the bottom nut and stud for loosening or tightening the top nut.**

- Lift the rear of the vehicle and remove the rear drive wheel.
- Loosen the four motor mounting bolts (Fig. 4.4.2) and nut on the motor adjusting bolt (Fig. 4.4.1). Loosen the motor adjusting screw several turns.
- Slide the motor toward the rear of the vehicle and remove the drive chain.
- Support the motor and remove the four mounting bolts.
- Slide the motor to the left until the drive sprocket is clear of the frame and lift the motor up from the vehicle.

To install drive motor:

- Place the motor in the frame with the wire terminals as shown in Figure 4.5.1.
- Once in place, install the top motor mounting bolt first, then install the remaining three motor mounting bolts (Fig. 4.4.2). Do not tighten.
- Install the drive chain and adjust as stated in Section 4.4.
- Install the rear drive wheel. Torque wheel nuts in a crossing pattern, to 65-ft. lbs.
- Connect the wire leads to the motor.

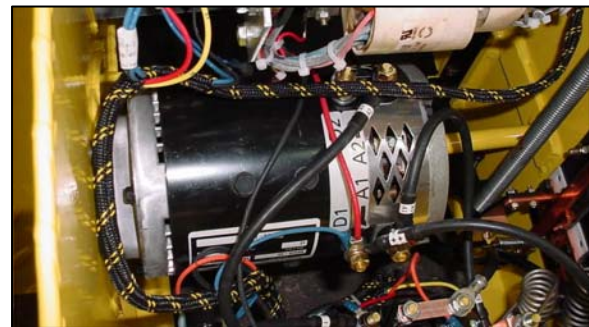


Figure 4.5.1

To remove and install motor brushes (Fig. 4.5.2):

- Remove motor as described above and remove the inspection headband (A).
- For each brush, remove the screw (B) from the brush lead, pull the brush spring away from the brush and remove the brush.
- To install, pull brush spring away from the brush holder, set the brush in the brush holder and release spring.
- Install screw into the brush lead.
- Install the inspection headband and replace motor.

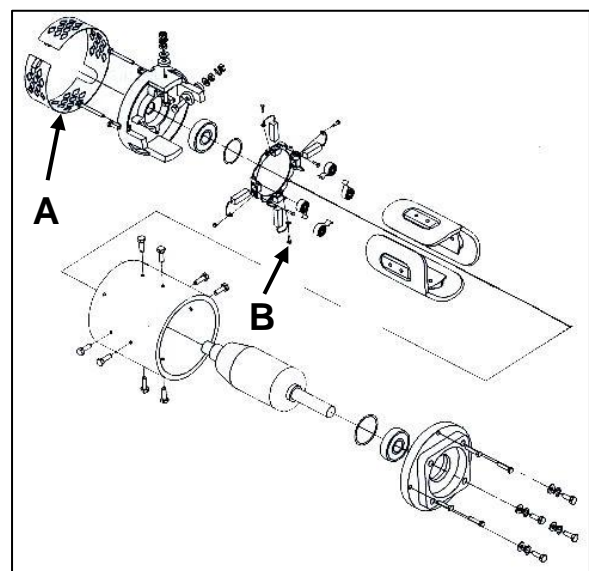


Figure 4.5.2

**NOTICE: Minimum brush length is 0.50" (1/2 inch). Whenever possible, always re-surface armature commutator when installing new brushes.**

#### 4.6 SPEED CONTROL SWITCH –Figure 4.6.1

##### **CAUTION**

Remove battery cables before starting work on the electrical system.

##### Slide Maintenance

- Lubricate the 3 contact bars (A) where the "L" brush (B) slides with good bearing grease. DO NOT use a graphite type grease.

##### **CAUTION**

DO NOT use metal objects to apply grease to the switch. Use your finger to apply grease.

- If the contact bars (A) are rough or worn, they must be replaced. PN 40324-00
- Check the spring (C) tension to be sure there is good contact between the "L" brush and the contact bars.

**NOTICE:** An arc will always occur when the "L" brush passes from low speed to the neutral bar. This arc flash may be observed after dark. This should not cause alarm.

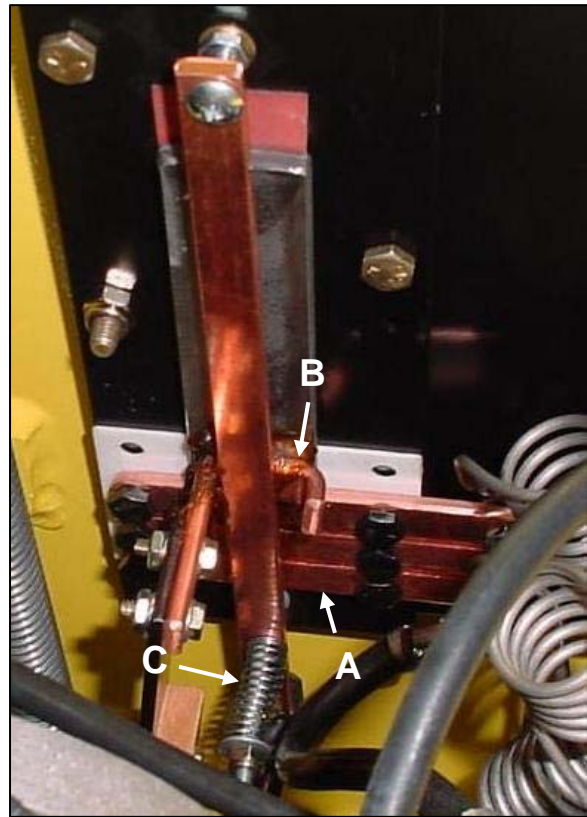


Figure 4.6.1

#### 4.7 FRONT AND REAR HUBS

##### Front wheel hub removal:

- Place the front of the vehicle frame on blocks to allow for wheel removal.
- Remove the nut and washer from the front axle and pull the axle from the front fork to remove.
- Remove the four lug nuts from the front wheel and hub.

##### Front wheel hub installation:

- Install the hub on the front wheel and torque the lug nuts to 35 foot pounds. Tighten lug nuts evenly in a star pattern.
- Insert the front axle through the front fork, wheel spacers and hub.
- Install the washer and nut on the front axle, tighten the axle nut to 120 inch pounds.

##### Rear wheel hub removal (See Figure 4.2.3):

- Raise the rear of the vehicle to allow the wheel to be removed.
- Remove the four lug nuts holding the rear wheel to the rear hub and remove the wheel.
- On the drive wheel side, remove the drive chain master link and the drive chain.
- Remove the dust cap.
- Remove the cotter pin and castle nut from the spindle.
- Remove the hub from the spindle. On the drive wheel side, it will be necessary to depress the treadle to release the brake before the hub with drum/sprocket assembly can be removed.

##### Rear wheel hub installation (See Figure 4.2.3):

- Install the hub on the spindle. On the drive wheel side it will be necessary to depress the treadle before the hub with drum/sprocket assembly can be installed.
- Install the castle nut on the spindle. Torque the castle nut to 120 inch pounds and then back the castle nut off two slots and install the cotter pin.
- Install the dust cap.
- On the drive wheel side, install the drive chain and adjust as stated in Section 4.4.
- Install the rear drive wheel. Torque lug nuts to 65-ft. lbs. Tighten lug nuts evenly in a star pattern.

#### 4.8 TREADLE – Figure 4.8.1

To remove:

- Follow the steps for rear wheel hub removal in Section 4.7.
- Disconnect the speed control arm (A) from the front of the treadle.
- Disconnect the treadle to brake linkage from the treadle.
- Remove the two spindle mounting screws from each of the treadle mounts (B).
- Remove the treadle and treadle mounts.

To install:

- Install the two screws through the treadle mounts into the spindles. Torque both screws to 150 inch pounds. Tighten the lower mounting screws securely with an open end wrench.
- Connect the treadle to the brake linkage to the treadle.
- Connect the speed control arm to the treadle.

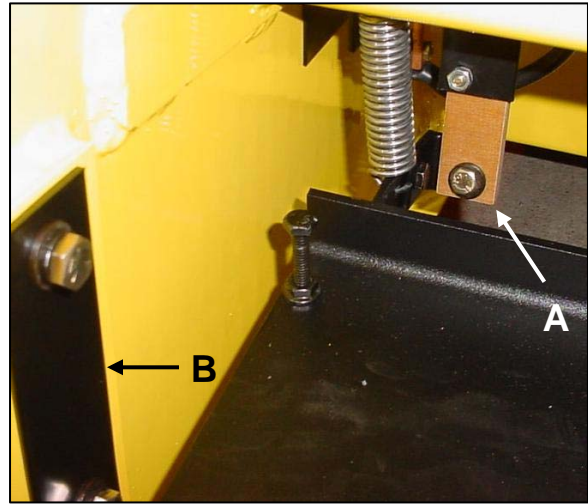


Figure 4.8.1

#### 4.9 SPINDLE

To remove:

- Follow the steps for rear wheel hub removal in Section 4.7 for both spindles. On the drive wheel side spindle follow the procedures outlined in the brake installation Section 4.2.
- Remove the two spindle mounting screws from each of the treadle mounts (Figure 4.8.1 B).
- Remove the lower mounting screws from each of the spindle(s) and remove the spindle(s).

To install:

- Install the lower mounting screws into the spindles. Do not tighten.
- Install two screws through the treadle mounts into the spindles. Torque screws to 150 inch pounds.
- Tighten the lower mounting screws securely with an open end wrench.
- On the drive wheel side spindle follow the procedures outlined in the brake installation Section 4.2.

#### 4.10 CHARGER– Figure 4.10.1

To remove:

- Disconnect batteries, negative cable first.
- Remove the charger cover plate.
- Disconnect the DC output leads from the motor (A) and solenoid (B).
- Disconnect the wires from the keyswitch (C) and battery state of charge meter which is located under the keyswitch.
- Remove the remaining mounting screws from the charger,
- Remove the charger from the vehicle.

**NOTICE:** Placing a block between the vehicle sides to spread them slightly will ease in removal and installation of the charger.

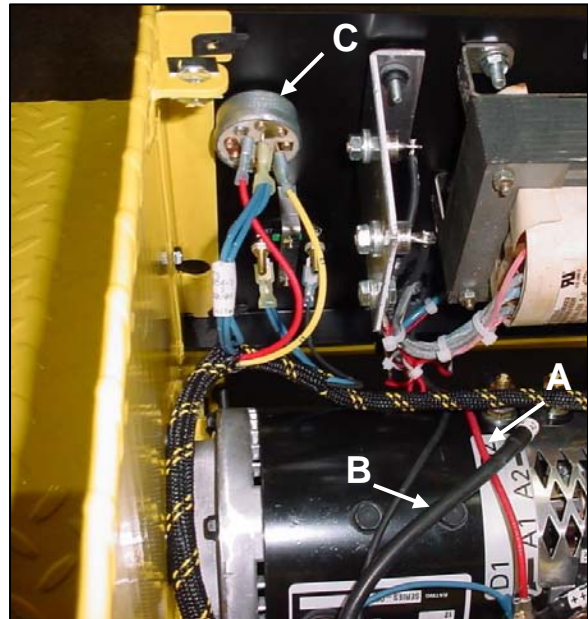


Figure 4.10.1

To install:

- Place the charger in the vehicle. Install the bottom two charger mounting screws. Do not tighten.
- Connect the wires to the battery state of charge meter and keyswitch.
- Connect the charger DC output leads to the solenoid and motor.
- Install the charger cover plate and tighten the bottom two charger mounting screws.
- Reconnect batteries, positive cable first then negative cable.

#### 4.11 CLEANING

Wash underside to remove all dirt and debris. Do not direct high pressure water at the speed switch or tops of the batteries.

Wash body and seat with a mild detergent. Do not use abrasives (bodies are painted). Frequent washings with mild soap will preserve the finish of your vehicle. For stubborn and imbedded dirt, a soft bristle brush may be used. Tar, asphalt, creosote and the like should be removed immediately to prevent staining of paint.

**NOTICE: Do not use harsh detergents, abrasives or cleaning solvents that contain ammonia, aromatic solvents or alkaline material to clean cab.**