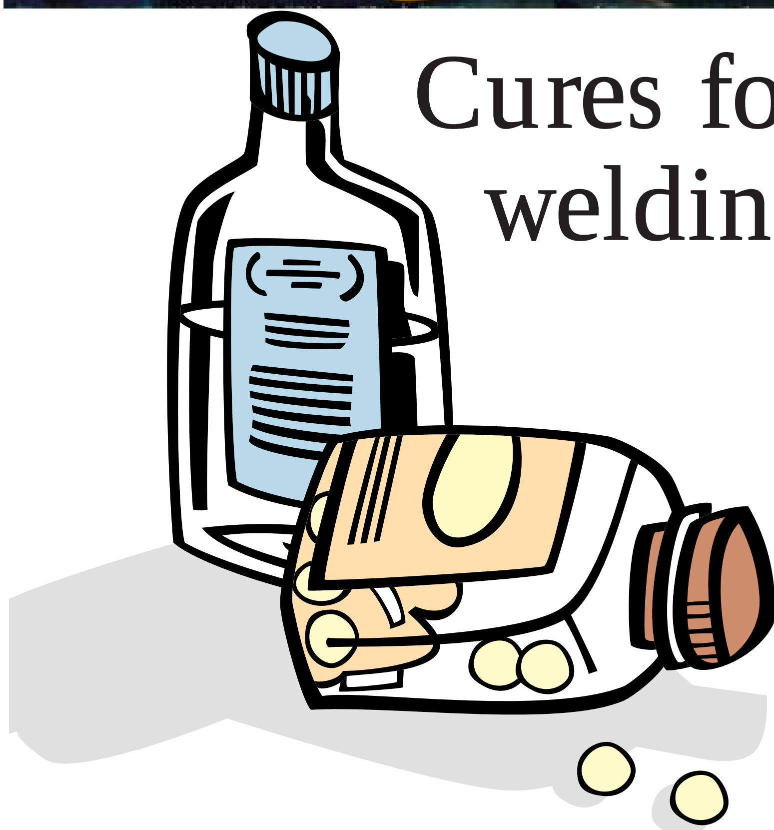
Figure 1

To test the secondary of the welding machine, the power should be turned off. With the electrodes open, the continuity between the top and bottom electrodes should be checked.



Cures for a sick spot welding machine

By Roger B. Hirsch

An unwritten rule says that when a spot welding machine breaks down, it usually will happen in the middle of a critical parts run and at the end of a shift.

However, in this situation, a plant manager does not want excuses but rather wants to get the parts finished—now. Period!

Enter a hero from maintenance, who can fix just about anything in the building except the spot welding equipment because, under normal circumstances, a spot welding machine can operate year after year with few problems that cannot be fixed by simply tightening a mounting bolt or water hose clamp.

Manufacturers of spot welding controls often receive panicky calls from desperate production people, often at 5 p.m. on a Friday (remember the unwritten rule). The following are some typical problems and their solutions.

Caution: Because many of the following tests involve working with full line voltage, no points in the control under power should be touched. If in doubt, the operator or technician should get an experienced electrician to do these tests.

Problem 1—Welding Machine Is Dead

One common indicator of this problem is no lights or displays are working on the welding control. While it might sound obvious, it is important to remember that welding machines do not work well without electricity.

A simple test with a volt meter at the incoming power source to the welding control should show if power is coming into the box. If the control has a circuit breaker or fused disconnect, full line voltage (230 or 460 volts, for example) should be present on the output side.

A common error is to measure from one power line to the cabinet ground or the conduit. This can give false readings because voltage runs through the welding transformer and shows a reading to the cabinet metal, even if one side of the power line is dead.

If power *is* present, the technician should check the welding control for small power fuses, making sure that power is turned off to the equipment *before* removing fuses for testing.

Most controls have both sides of the incoming power to the control fused. On some controls, fuses are located on a separate stepdown transformer in the cabinet. In other controls, fuses are located on or near the power supply. The operator should check for continuity on these fuses.

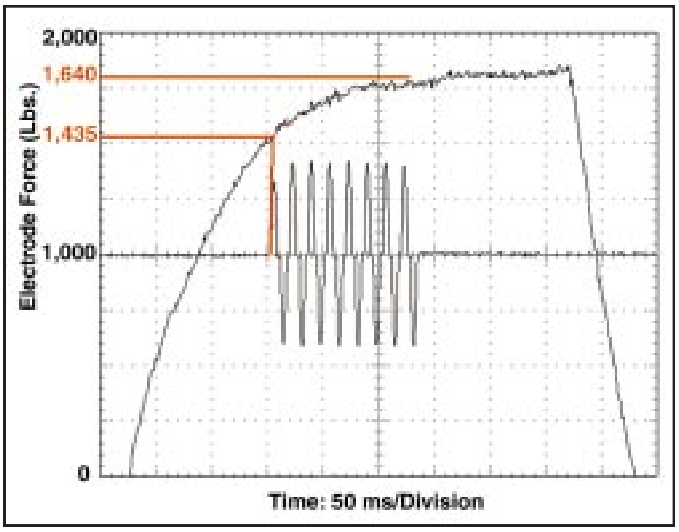


Figure 2

Expulsion usually occurs because too little time is allowed for the required welding force between the welding electrodes to be achieved before welding current starts to flow.

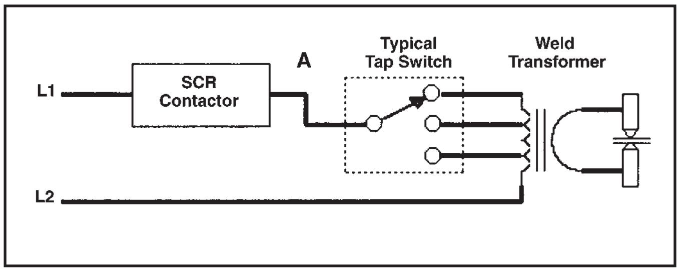


Figure 3

A resistance welding control switches voltage only on one side of the power line.

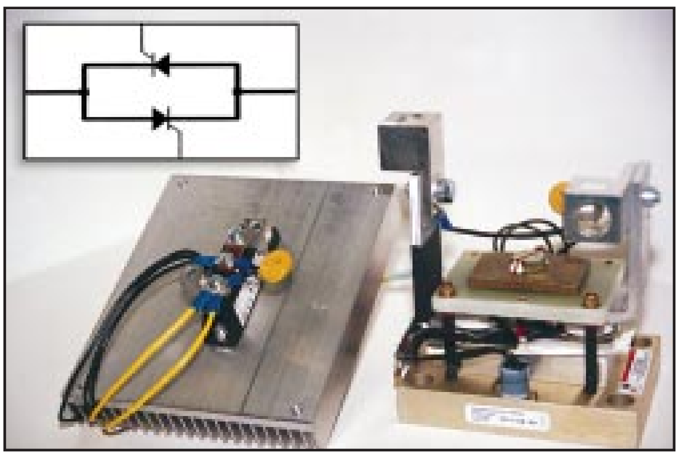


Figure 4

Typical air-cooled (left) and water-cooled (right) SCR contactors are shown. (Electrical schematic shown in insert.)

If the fuses are fine, power can be turned on and the voltage into the control measured. If the control has a separate stepdown transformer, this usually will be 115 volts alternating current (AC). If the control has a utility 115-volt AC output terminal, the technician should check this point to ensure the reading is a normal 115 volts.

Any blown fuses should be replaced with ones of exactly the same type and rating. These fuses are selected by the manufacturer to protect the electronic components.

Using a larger-value fuse can cause major damage to a control that started out with only a small problem. This can happen, for example, when a shorted $1.50 logic chip burns out and destroys a then-unprotected $200 power supply board.

If there is a schematic drawing for the welding control that includes voltage test points, the technician should read and record these measurements. By giving the numbers to the control manufacturer's serviceperson, it is possible that a solution can be found over the phone.

Problem 2—Control Has Lights but Will Not Cycle

If closing the foot (or hand) initiation switch does not elicit an action, the most common cause is a bad switch. The fact that a switch mechanically closes does not guarantee that the welding control will cycle.

Many switches are designed for high-current switching (amps). Welding controls typically use low voltage and very low current (milliamps) for initiation. Over a period of time, the contacts inside a switch can form a very thin oxide layer that blocks conduction of electricity.

To check this, the technician can unwire the initiation switch and replace it with another switch. If the machine then operates, the problem is solved.

Problem 3—Machine Cycles, but Tips Do Not Close

If the machine cycles but the welding electrodes will not close, it could be the result of a bad air solenoid or a non-electrical problem, such as insufficient air to the system.

Figure 5

Most controls have a MOV, which should be replaced when the SCR contactor is replaced.

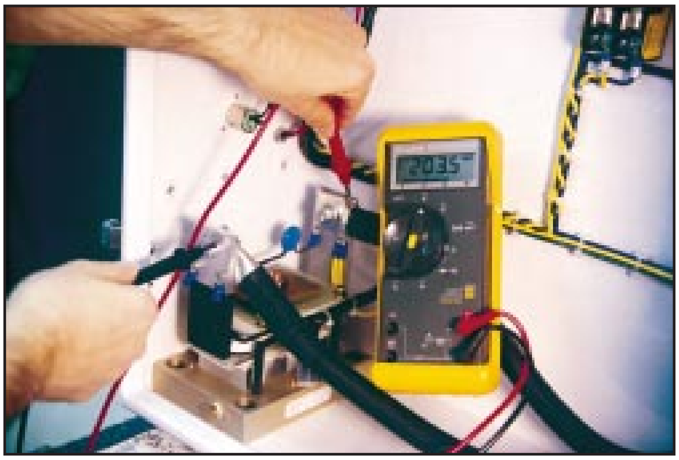


Figure 6

If the technician suspects that the SCR contactor has shorted, a voltage meter can be installed across the two large power terminals.

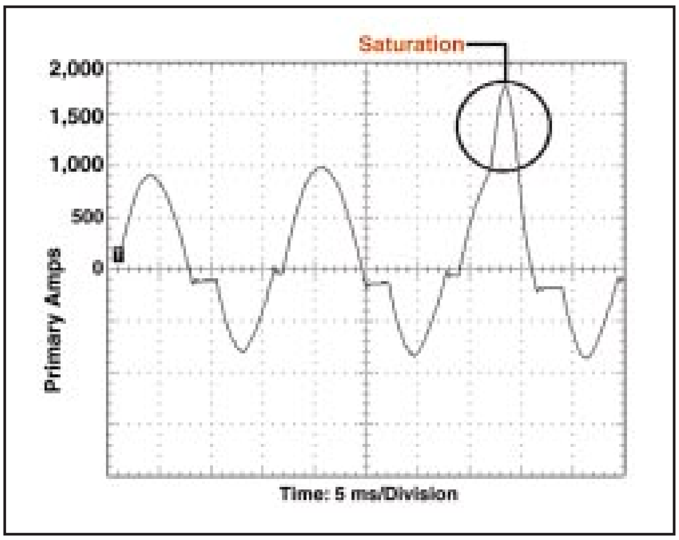


Figure 7

A sudden, dramatic sound change often occurs when the welding transformer is operated in an unbalanced condition in which the AC that flows into the transformer is more in one polarity than the other.

The technician first should check that sufficient air pressure (typically 20 PSI minimum) is shown on the air regulator's gauge.

If air pressure is present, the technician next should check if the solenoid valve that operates the machine's cylinder has a manual operating button. If it does, this button should be pushed to see if the cylinder operates. If it does not close the welding electrodes, the solenoid valve should be replaced.

If the manual operator works in this test, the problem might be in the solenoid valve coil or the welding control valve drive circuit. To check these, the technician should locate the terminals on the welding control that provide voltage to the welding solenoid valve.

While most controls use 115 volts AC to operate the solenoid coil, the solenoid valve coil's nameplate should be checked to confirm this. With the equipment initiated, the technician should check the control's output terminals for voltage when the system has been initiated.

If voltage is present and the valve does not operate, the test should be repeated on wires at the coil end. If voltage still is present and the valve still does not operate, the valve coil should be replaced.

If no voltage is present, output fuses for the control's valve terminal should be checked. If these are all right, the problem probably lies in the control.

Problem 4—Welding Electrodes Close, but No Weld Occurs

If the welding electrodes close but no weld occurs, one of the following maintenance tips may be appropriate.

Problem in Machine's Secondary. By far, the most common cause of this condition can be found in the machine's secondary circuit.

It is not uncommon for welding electrodes *not* to touch the part after they have been adjusted or after new ones have been installed. The welding machine should be adjusted so that at least ¼ inch more travel (overtravel) is available after the electrodes have touched.

Another very common problem occurs when someone has wrapped Teflon® tape around the electrode shank to stop water leaks. This certainly stops the leak, but, unfortunately, it also electrically insulates the electrode.

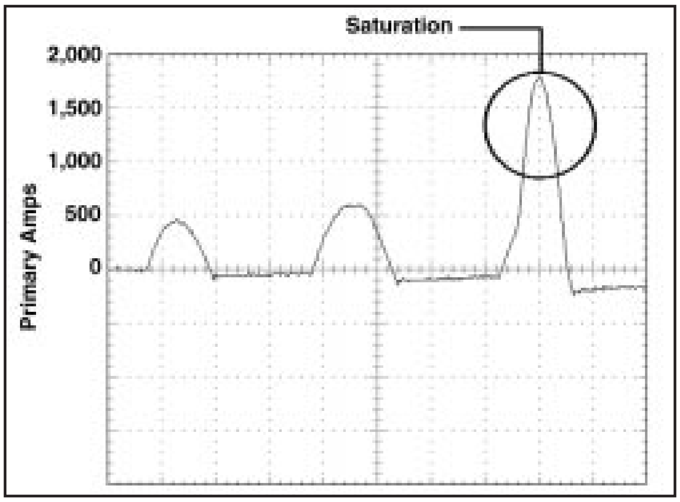


Figure 8

One cause of saturation, which is quite rare, is a bad SCR contactor. In this case, only one polarity of the line voltage is conducted.

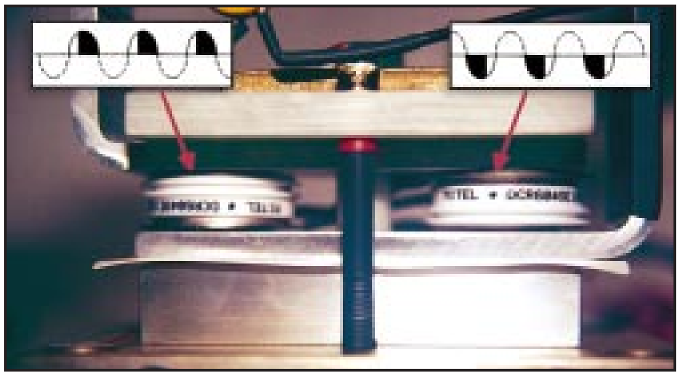


Figure 9

The SCR is an assembly of two individual SCR elements installed back-to-back.

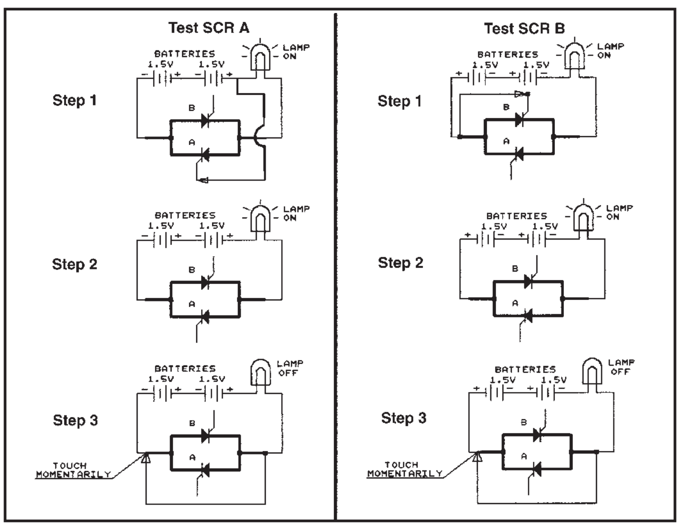


Figure 10

To test operation on both sides of a removed SCR contactor, step one is to connect two 1.5-volt batteries in series and a 3-volt flashlight bulb across the SCR contactor.

A good way to test the secondary of the welding machine is to first turn off the power. Then, with the electrodes open, the continuity between the top and bottom electrodes should be checked (see **Figure 1**).

If the secondary is working, the measurement should be about 1 ohm or less. If the reading is high, the technician should go across each mechanical junction of the welding machine secondary until a high value is found.

Heavily used spot welding machines commonly have oxidized connections. If this is the case, the connection should be opened and the surfaces cleaned with a fine abrasive and polished. The use of coarse abrasives will make the problem worse a few years down the road.

Terminal connection pads often are silver-plated. If this plating has been removed by the cleaning process, it can be replaced using a commercial silver powder such as Cool Amp®.

Technicians should keep in mind that these junctions are conducting thousands of amps. Secondary connections should be tightened fully, and questionable bolts always should be replaced.

Open NO-WELD Switch Problem. Most controls have input terminals for connection of an external NO-WELD switch. If this external switch is broken in the NO-WELD position (open contacts), or if it has dirty contacts, the welding machine cycles but produces no heat.

If a machine has such a switch, the technician should temporarily jump the NO-WELD terminals on the welding control. If it comes to life, the switch should be replaced.

Transformer Tap Switch Problem. Many welding machine transformers have a tap switch that is adjusted by rotating a large handle on the outside of the welding machine or on the welding transformer.

After many years of use, these switches or the connections to the switch can become loose and oxidized. To check this, the technician can rotate the tap switch several times to see if the welding machine starts operating correctly. Also, with power turned off, the technician can check the wiring connection to the tap switch inside the welding machine.

Problem 5—Major Metal Expulsion When Electrodes Close

Major metal expulsion occurring just as the welding electrodes touch, blowing copper and metal across to the next aisle, is another common resistance welding equipment problem.

Often, the welding electrodes will even "weld" together. In this case, one of the following problems may be responsible.

1. The welding machine was fired too soon. Expulsion usually occurs because too little time is allowed for the required welding force between the welding electrodes to be achieved *before* welding current starts to flow (see **Figure 2**). In this case, the electrodes close "live" and act like an arc welding machine.

If the welding control contains a differential pressure transducer system, the technician should ensure that it is operating correctly and has been set to a reasonable value. Using this type of device provides the best protection against premature firing of a welding system.

On some welding machines, a pressure switch is used to check for air pressure in the welding cylinder. These units usually are not accurate and can cause the control to fire much too early.

Also, a pressure switch can measure pressure only on the top chamber of the welding cylinder, ignoring the pressure on the underside of the cylinder piston that reduces tip force. The pressure switch contact should be *open* until the electrodes have closed on the part and the air pressure has come to full force in the cylinder.

If the control does *not* have a transducer, the technician should ensure that the squeeze time set in the program is long enough. This squeeze time is set in cycles (1 cycle = 1/60 second).

If, for example, it takes 1/4 second (15 cycles) for the electrodes to touch and another 1/4 second for the air pressure to come to full pressure in the air cylinder, the squeeze time should be set to at least 30 cycles (1/2 second).

2. Leaking welding cylinder. Expulsion also can occur if the welding machine's air cylinder has a large internal cup seal leak, which prevents the cylinder from producing the required welding force.

Welding with very low force causes major expulsion and electrode sticking. If the cylinder has this internal leak, air comes out of the solenoid valve's exhaust port when the welding electrodes are closed.

Problem 6—Welding Electrode Meltdown

If the electrodes close "live," weld together, and continue heating until they have been reduced to a molten glob, the operator probably has pulled the disconnect before calling maintenance.

There are two possible causes for an electrode meltdown.

1. Transformer grounding. One possible cause of welding electrode meltdown is a welding transformer with a primary winding that has become shorted to the welding machine case. While this is a fairly unusual condition, it can happen.

As shown in **Figure 3**, a resistance welding control switches voltage only on *one* side of the power line. The other side of the power line goes directly to the welding transformer.

To test for this condition, the technician first should turn the power off and then remove the wire going from the silicon-controlled rectifier (SCR) contactor to the welder transformer (point A), and then insulate the end of that wire.

With the power then turned on, a weld sequence should be attempted. If the problem still occurs, the transformer should be checked and probably replaced.

2. SCR contactor shorted. A more common problem is a shorted SCR contactor. This device actually is two SCRs mounted in a single water- or air-cooled assembly. **Figure 4** shows typical SCR contactors and a schematic drawing of the assembly.

SCR contactors normally operate for long periods without problems, but they can fail. Unfortunately, 99 times out of 100, they fail in the shorted condition.

SCR contactors fail either because of excessive internal heat or because of a high-voltage spike across the device.

Excessive internal heat can occur when the SCR contactor is not being cooled properly. On a water-cooled SCR contactor, the flow of cooling water through the SCR heat sink should be at least a half-gallon per minute. If there is a restriction or if the back pressure on the return hose is too high, water will not flow properly.

High voltage can happen when lightning strikes an outside power line or when the welding machine is run with excessive expulsion for a long period. A properly sized SCR contactor should have a voltage rating of at least three and a half times the line voltage.

Most controls have a metal oxide varister (MOV) installed across the SCR contactor to clamp high-voltage spikes around the switch (see **Figure 5**). When an SCR contactor is replaced, this MOV also should be replaced as preventive maintenance.

The SCR contactor is used as a solid-state switch to pass electricity to the welding transformer when the weld is made. At all other times, it should be an open switch. If the SCR contactor is shorted, electricity flows through the welding transformer constantly.

On some controls (typically automotive type), a two-pole contactor is installed between the welding transformer and the control. In this case, voltage through a shorted SCR contactor flows only during the welding sequence but still causes serious copper melting.

3. Shorted SCR contactor test. If the technician suspects that the SCR contactor has shorted, a voltage meter can be installed across the two large power terminals, as shown in **Figure 6**. When power is turned on to the control, the line voltage should be present across these points (unless the control has an isolation contactor installed).

If the line voltage *cannot* be read at these points, the technician should turn the power off to the control and disconnect the wire going to the welding transformer. With the power still *off*, continuity across the same two terminals should be measured.

If the SCR is shorted, it will read about 1 ohm. If the SCR is not shorted, the reading will be 1,000 ohms or more. This usually is a reading of other components, such as snubbers, that are installed across the SCR contactor.

Problem 7—Loud Transformer Growling, Saturation

A properly operating welding transformer has a smooth humming sound when welding. If, however, the operating sound suddenly changes dramatically, the system has a problem.

When this occurs, continued use of the machine can cause permanent damage to the welding transformer and the SCR contactor. Under this condition, line fuses sometimes blow or circuit breakers open. Also, welds that are produced will be very weak or might not stick at all.

This problem often occurs when the welding transformer is operated in an unbalanced condition in which the AC that flows into the transformer is more in one polarity than the other (see **Figure 7**).

The difference produces a direct-current component in the welding transformer and causes the transformer to go into the saturation condition. When this happens, the primary current (line current) will jump from hundreds of amps to thousands. This excessively high amperage can cause the power wires feeding the machine to slap within their conduit.

SCR Problem. One cause of saturation can be a bad SCR contactor. This is quite rare, but it can happen. In this case, as shown in **Figure 8**, only one polarity of the line voltage is conducted.

The SCR contactor actually is an assembly of two individual SCR elements installed back-to-back, as shown in **Figure 9**. One of the SCR elements conducts the positive side of the AC line, and the second conducts the negative side.

If all are working correctly, these SCR elements are fired alternately at the same timing (relative to the line voltage frequency) to provide balanced AC to the welding transformer. However, if only one of the SCR elements operates, the welding transformer saturates quickly.

The technician can use the following steps to test operation on both sides of an SCR contactor that has been removed from the welding control:

1. Connect two 1.5-volt batteries in series with a 3-volt flashlight bulb across the SCR contactor, as shown in **Figure 10** (test SCR A).

2. Touch the gate wire from either SCR to the + side of the battery pack as shown. Note that the gate wire is connected to the center of each individual SCR. If the light does not turn on, connect the gate wire from the remaining SCR to the + side of the battery pack. The SCR should stay on.

Once the light is on, remove voltage from the gate wire. The SCR should stay on.

3. Momentarily touch a wire from one side of the SCR contactor to the other, and the light will become very bright. Remove this wire and the light should go out.

Now, reverse the battery pack / lamp wires to the SCR contactor and repeat the same test with the remaining SCR gate wires as shown in Figure 10 (test SCR B).

If both sides check out properly, the SCR is operational.

Control Problem. A second and more probable cause of saturation is an improperly operating welding control.

Controls synchronize firing of the SCR contactor to the line voltage frequency. If the circuitry is not operating properly, weld transformer saturation occurs, as shown in Figure 7.

Also, most welding controls have fuses on the SCR firing circuits. The technician should check these fuses and replace them if they are blown. Additionally, firing wires (gate and cathode wires) coming from the SCR contactor to the control should be checked to ensure that they are connected properly and tightened. ●

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