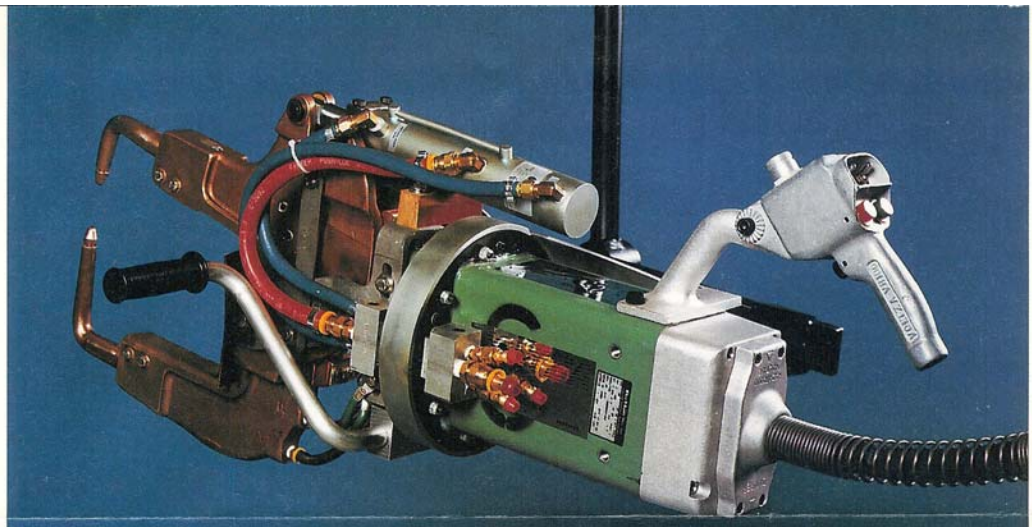

USING PORTABLE TRANSGUNS FOR RESISTANCE SPOT WELDING

Choosing equipment for manual applications

By Joseph Nedorezov

Resistance welding has been around for more than a century and remains a leading manufacturing process because of its simplicity, high productivity, and relatively low cost. Over the years, many variations of the resistance welding process have been developed and have found their place in the industry.

This article discusses resistance spot welding, in which the welding current is passed between two copper electrodes. The heat generated at the surface of the joined pieces plus the tip force applied to the parts form a welding joint. Resistance spot welding is mainly used to weld steel, but can also be used on stainless steel, aluminum, titanium, and other exotic alloys.

The process can be used in manual, robotic, and stationary machine applications. The only difference among the applications is how the component is introduced to the welding device.

Manual welding can be performed by the operator's introducing a part to the welding machine and pushing a foot pedal or palm buttons, or by the operator holding a portable welding machine and moving it around the part being welded. These portable machines, called portable welding guns, are the focus of this article.

Types of Manual Resistance Spot Weld Guns

Portable spot welding guns can be single-sided, in which the force is applied by the operator and can be made more uniform by application of the springs, or two-sided, in which the force is applied by an air- or oil-operated cylinder/diaphragm or a manual toggle clamp. The most common operations have air-operated cylinders in which the size of the cylinder is selected to apply the necessary pressure for the material being welded.

This paper focuses on one variety of the manual weld guns—direct force applied—which have two electrodes closing on the weld metal. There are two types of direct-force-applied guns: conventional weld guns, also referred to as remote transformer or cable-type guns, and transguns.

Conventional weld guns have a large transformer located remotely from the weld gun. The welding current is delivered to the weld gun arms through a large, water-cooled secondary cable.

Transguns have a smaller transformer located right on the weld gun, from which the current is delivered through short jumpers or shunts that are air-cooled. Transguns are also called integral weld guns, because the transformer is part of the unit.

The size of the transformer depends on the kVA rating. Because of the lower electrical efficiency of a remote-mounted transformer, the system requires the transformer to have a larger kVA to supply the secondary current needed to

perform the weld. A transgun design is more efficient since the current path is reduced because of the close proximity of the transformer to the gun package. This design characteristic allows the use of a smaller kVA transformer which is also smaller in size.

Naturally, the physics of the process using either type of weld gun is the same; the same welding current is required to weld the same metal combination. However, because the transformer is located near the arms of a transgun and there is no water-cooled cable restricting reach, the transgun is smaller and has better electrical efficiency.

For example, an average-sized transgun with a 54 kVA built-in transformer can deliver a maximum secondary current of 19,000 amps with about 320 amps on the primary side. This can result in substantial power savings per year.

Safety

Historically, conventional weld guns were used in various applications because the weld controllers did not have the ability to detect and react to any hazard associated with using primary power connected directly to the weld gun. With present safety devices, transgun safety levels are higher.

As with any electrical device, transgun safety requires some degree of user awareness. The manufacturer's guidelines for system design outline all the necessary requirements for a safe system. These may be considered "minimum" requirements as there are other levels of protection to consider.

When dealing with a manufacturer or distributor, specify at least the minimum requirements for installation. It is enough to mention to the supplier that the system must meet the recently published requirements of the Resistance Welder Manufacturers' Association (RWMA) Bulletin #5 (paragraph 5-015.68.04 Special Considerations for Portable Transguns). Before these requirements, safety features were offered as "optional."

Safety devices installed in the transgun system also allow the early detection of potential problems that may affect the performance or functions of the transgun.

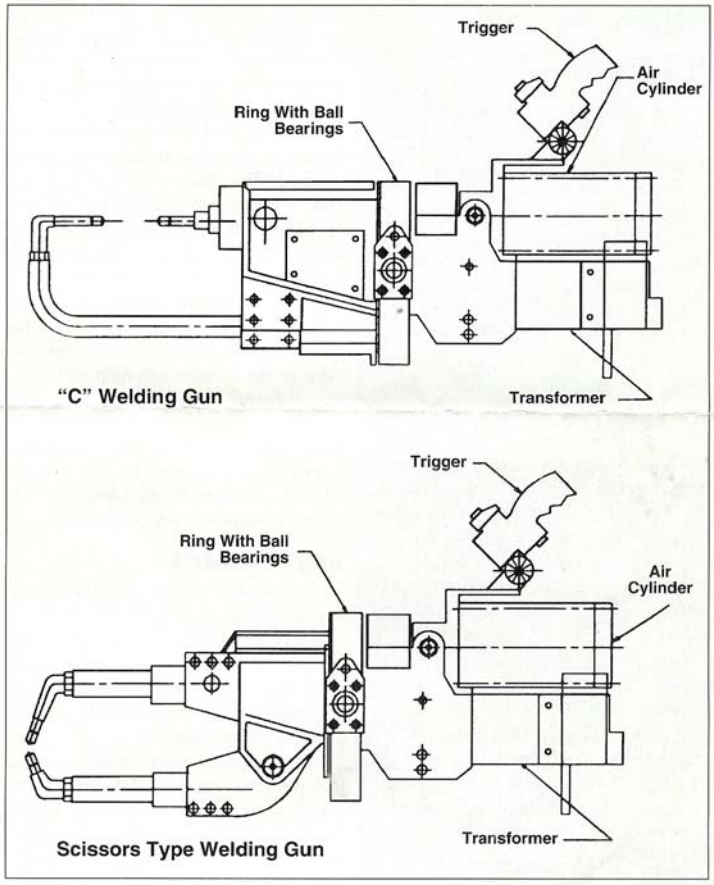

Figure 1

There are two basic configurations of portable transguns, the "C" gun and the "scissors" gun.

The key to safety is good grounding. System requirements must include:

1. A grounding integrity monitor. The ground wire must always be attached to the gun body.

2. A ground fault current relay. There can be no leakage to the ground through the insulation.

3. A grounded shield cable. The primary cable from the transformer to the weld controller must be surrounded by a grounded shield.

Additional features that can be implemented include an isolation contactor and extra strain relief for the primary cable. The isolation contactor removes the power from the gun while it is not welding. The extra strain relief for the primary cable minimizes the possibility of the cable being shorted on the transformer case.

Design

Two basic configurations for portable transguns are the "C" gun and the "scissors" gun (see **Figure 1**). The selection of the weld gun type can be personal preference, but sometimes it is dictated by the part configuration. For

SELECTING THE OPTIMUM SYSTEM

To minimize problems associated with the purchase and start-up of new transgun equipment, the following steps are suggested:

A. Identify the number of welds per part, the number of parts per hour/per day, the material combination, and thickness of the sheets. The welding gun manufacturer or distributor will need this information to determine the size of the transformer.

B. Obtain the information on the size of the biggest part you intend to weld and its metal thickness.

C. For electrode selection, determine the size of the caps needed (usually a size 2 cap covers most of the applications). The cap size will depend on the welding current, tip force, and metal thickness. The weld gun supplier should be able to identify the proper electrodes.

D. The weld controller can be any brand as long as it satisfies the safety requirements. For high-volume production, a stepper option should be considered. The transformer size may then need to be upgraded to provide enough current capacity for the stepper.

E. When deciding between manual and special machinery, consider your volume of production and part orientation. If you have low-volume production, but the orientation of the part is the same and parts can be carried by the operator, the best would be a stationary standard welding machine (for example, small boxes, brackets, etc.).

F. Verify what cooling requirements may be needed. The use of running water is cost-prohibitive, and "city water" with chlorine may ruin internal components of the gun or clog up tubing.

G. Review possible applications for at least three years. If you might be welding aluminum, a high-frequency transformer could be the best option to purchase. By the same token, you can purchase the equipment and advertise the ability to weld aluminum.

example, the C gun is a better choice for welding around a door opening on a small flange. A scissors gun would be preferred when welding large, deep boxes requiring a long reach.

Many portable transguns are designed so that the arms can be easily replaced. The ability to interchange the arms within each manufacturer's line contributes to the versatility of the guns because the cost of arm replacements is less than replacing the whole unit.

Some transgun designs have the solenoid valves incorporated into the gun body. Short hoses for air from the valve to the cylinder can help make operation faster.

Water cooling is arranged so that all major components (transformer, tips, arms, bus bars) are in a series. The heat generated in the transgun is much less than that generated in the conventional guns.

Ergonomics

In general, transguns are well balanced. The transformer on the back provides a natural counterbalance to the arms. The ring with ball bearings allows easy rotation around the main axis—up to 360 degrees. By design, the gun can be made and balanced by the manufacturer.

The engineer must make sure the gun will fit the cross section and that the transformer sizing is adequate. Other concerns, such as proper hanging of the gun in the most convenient position, are taken care of by design.

Manual transguns are designed so that the center of gravity is located close to the center of symmetry. In other words, weight is distributed equally on both sides of the pivot points in all directions. For example, the transformer and the air cylinder on one side counterbalance the weight of the electrode arms on the other side of the pivot point.

Typical installations require the use of the balancers to raise and lower the gun. Balancers can be spring or air.

A spring balancer can be adjusted so that the weld gun floats to the same preset height. It has a preset weight range for each spring. This requires replacement of the balancer when the weight of the gun exceeds the nominal. Usually, the weight of the gun does not change, except where the transformers or the arms must be switched for a different operation.

An air balancer offers a wide weight range and covers most applications with only one size of balancer. In general, air balancers involve a higher initial investment.

Flexibility

Transguns provide flexibility on the job. A transgun can be used up to 100 feet away from the weld controller. This distance allowance leaves room for the operator to travel within a work cell.

Transguns can be installed on a cart along with the weld controller, water circulator, etc., and moved around the shop floor to do repair or from one production cell to another. Its modular design allows it to be switched by disconnecting hoses and primary cables.

Cost Efficiency

Transguns offer some features that aid cost efficiency.

New-generation transguns have high-frequency direct current (DC) transformers that require three-phase power and, in general, a more expensive weld controller, but they provide a well-balanced load on the power bus.

Typically, transguns require one-gallon-per-minute water flow through the system. Also, an extra structure is not needed to support the transformer and the control package with the valves, lubricators, etc.

Conclusion

An array of resistance welding equipment options is available. It is important to review all the aspects of an application to select the best options available. ●

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