Arc Welding Robot - A Review
Introduction

During Post Second World War, the manufacturing Industries witness a stiff raise in demand in the goods. With the age old manufacturing processes which were overall depend on human skill, this rise demand of industrial goods were almost impossible to meet. This resulted in raise in the cost of skilled manpower, in many fold, day by day. In addition to this, the products manufactured by employing man-power were having variance in quality due to differential levels of individual skills. Meanwhile, the market competitions also increased in many fold resulting in very thin margin in the market place. This leads to a situation where the market expected quality of the end product were very high as well as the net margins were very low.

This contributed to think usage of more & more automations in manufacturing, which reduced the skill requirement of the individual labor and ensure the repetitive accuracy in the end product. With the advent of electrical and electronics technologies, more and more CNC control systems were started being used in the industries mainly for two axis mechanized movements with the help of DC motors with Closed looped Feed back control drives. Switching devices such as BJT (Bi-Junction Transistor), MOSFET (Metal Oxide Semiconductor Field Emitting Transistor) & IGBT (Insulated Gate Bi polar Transistor) with very high dynamic response & low resonance started replacing the so called Thyristor drives and thereby the size o& weight of the control systems started becoming smaller but with much more improvement in terms of reliability and efficiency.

Under this back drop, the manufacturers started using robotic arms for assembly jobs to increase the productive output with highest accuracy. This results in lesser dependency on manpower although the initial investments for capital equipment were high.

Welding and cutting operations play an important role in fabrication industry. The employment of Robotic arm in carrying out welding for large volume similar type of jobs, particularly in automobile Industries opened up new opportunities in developing the efficiencies of welding Robots.
With the growth in overall Industries and in particular to infrastructure Industries, more & more companies started using Robotic automation for heavy fabrication.

**Base, manual and external axes**

The systems offered by the Robot Manufacturing companies are mostly turn key solution for Robotic welding and mainly consist of a programmable Six axes Robot and Work Piece Positioner and job handling facilities for welding of thick plates to avoid manual handling and welding machine depending upon the process of welding and the material.

A welding robot consists of six internal axes and the controller unit is capable to monitor up to Sixteen axes. This means upto Ten external axes for positioning of the job and Six axes of Robot.

The robotic system also consists of sensors for proper arc sensing and self programmed Mig torch cleaning system for Mig welding. The Torch cleaning system (by using Compressed Air, Rotary Magnet cleaning etc) and Torch changing system (for changing the Single wire Torch to Twin wire Tandem Torch system depending upon the weld seam requirement) are programmed from
the controller unit. These operations are carried out while the robot is carrying out the welding cycle operation and thereby increases the service life of the parts being used.

The welding Robots are specified under two categories i.e.

- The Working Envelope
- The Load carrying Capacity.

**Working Envelope :-**
The Working envelope of the Robot depends upon job configuration. This means that the bigger is the job, the bigger the working envelope and hence the requirement of additional axes movements of the Robot in order to complete the welding of all most all the seam of the job. This can be achieved by means of Over head Linear Track with Horizontal and vertical slides as well as Floor mounted C frame with Horizontal and vertical moving cross slides on which the Robot is mounted.

**Load carrying Capacity**
The Welding Robot is required to carry the welding torch which is normally less than 10 kgs and hence the maximum load carrying capacities of all the robot is within 15 Kgs only. However, higher load carrying capacities are required for Spot welding and pick and place robots.
The construction of the axes of the robot results in so-called revolute joint design or articulated arm construction. The principle of the revolute joint design allows a hemispherical working range. Robot Axes – the moving parts are guided components driven independently and executing controlled movements. Robots in revolute design are similar to the human arm with hand and fingers. Therefore we often speak of a robot arm when describing the robot mechanics.

Each robot axis represents a degree for the movement of the body and the axes of a robot. Therefore it is also called “Degrees of Freedom”. Three axes out of six help to reach any point in a rectangular/spherical space and the rest three axes are required for the different angle adjustments of a body on any point.

The Views Of The Six Different Axis Of The Robot
**Programming elements** are the link between operator/programmer and the computer. The programming task will be made via the teach pendant, only in certain cases via the keyboard (e.g. the treatment of the text for the programming run).

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**TECHNICAL DESCRIPTION OF WELDING ROBOT**

- Robust & articulated arm construction.
- All axes have a large indexing range in articulated arm principle providing
  - Greater Dexterity
  - Large Hemispherical Working Range
- Slim and compact design provides rigidity.
- Dynamics and backlash-free transmission of power to the axes ensures speed and repeatability for excellent path welding.
- No extra equipment such as a stabilizer, air cylinder or counter weights required to increase dynamics.
- Integrated brakes with motor so operation is in closed circuit principle preventing any dangerous movement of the axes, even on occurrence of power failure.
- Low power consumption due to digital AC-drive technology.
These features provide following Advantages:

1. Long service life due to long intervals between maintenance works.
2. Easy integration of mechanics into production lines due to the low floor space required and optimum accessibility of the work piece.
3. High dynamics guarantee excellent path accuracy with high speeds and sensors guarantee optimum quality despite tolerances.
4. Enclosed cable guides prevent damages from external influence.
5. Excellent productivity due to short acceleration and delay times with high-speed spatial movement of the robot.

Technical Data of Robot :-

The welding robot is a robust industrial robot in articulated arm construction. The articulated arm principle where all axes have a large indexing range shall give the welding robot greater dexterity as well as a large hemispherical working range. The robot arm shall provide rigidity with a slim and compact design. With the high dynamics and backlash-free transmission of power to the axes, it ensures accuracy, speed and repeatability for excellent path welding. The rigid construction of Robot should be evident in that no extra equipment such as a stabilizer, air compensating cylinder or counterweights is required to increase dynamics. The brakes which are integrated in the motor operate according to the closed circuit principle and prevent dangerous movement of the axes, even when a power failure occurs.
Advantages and benefits for the end user:

- Robust construction
- Optimum dynamics with a high accuracy
- Slim and compact design
- Digital AC-drive technology
- Absolute path measuring system
- Large hemispherical working range

therefore:

→ long service life and long intervals between maintenance work
→ a repeatability of less than 1/10 mm ensures exact working quality
→ easy integration of mechanics into production lines due to the low floor space required & low weight
→ optimum accessibility of the workpiece
→ high dynamics guarantee excellent path accuracy even with high travel speeds
→ easy integration with sensors guarantee optimum quality despite workpiece tolerances
→ enclosed cable guides, therefore no damages caused by external influences
→ excellent productivity due to short acceleration and delay times and
→ high-speed spatial movements of the robot
→ flexible use of the robot due to the articulated arm construction providing greater dexterity irrespective of mounting position

Technical data of robot mechanics:

<table>
<thead>
<tr>
<th>Configuration:</th>
<th>revolving joints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of axes:</td>
<td>6</td>
</tr>
<tr>
<td>Load capacity:</td>
<td>15 kg</td>
</tr>
<tr>
<td>Drive:</td>
<td>one digitally controlled AC servo motor per axis</td>
</tr>
<tr>
<td>Path measuring system:</td>
<td>digital, absolute (resolver)</td>
</tr>
<tr>
<td>Repeatability:</td>
<td>( \leq \pm 0.1 \text{ mm} )</td>
</tr>
<tr>
<td>Working range :</td>
<td>hemispherical</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>( \varnothing \approx 4430 \text{ mm} )</td>
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<tr>
<td>Floor space:</td>
<td>500 x 550 mm</td>
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<tr>
<td>Weight:</td>
<td>205 kg</td>
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</table>

<table>
<thead>
<tr>
<th>Rotating angle of axes:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis 1</td>
<td>340 °</td>
</tr>
<tr>
<td>Axis 2</td>
<td>200 °</td>
</tr>
<tr>
<td>Axis 3</td>
<td>290 °</td>
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<tr>
<td>Axis 4</td>
<td>358 °</td>
</tr>
<tr>
<td>Axis 5</td>
<td>270 °</td>
</tr>
<tr>
<td>Axis 6</td>
<td>600 °</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. speed of axes:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis 1</td>
<td>151 °/s</td>
</tr>
<tr>
<td>Axis 2</td>
<td>151 °/s</td>
</tr>
<tr>
<td>Axis 3</td>
<td>176 °/s</td>
</tr>
<tr>
<td>Axis 4</td>
<td>290 °/s</td>
</tr>
<tr>
<td>Axis 5</td>
<td>338 °/s</td>
</tr>
<tr>
<td>Axis 6</td>
<td>410 °/s</td>
</tr>
</tbody>
</table>
Technical description of Controller Unit:

When developing the controller unit, the most important is to put a robust and user-friendly controller unit at the customers’ disposal which is provided with sufficient reserves and convinces by high reliability and flexibility. These characteristic features could be obtained due to a modular design, less subassemblies as well as the use of standard components. An industrial PC serves as central processing of the robot controller. The central processing unit unit which is designed as multiprocessor system has a considerably short interpolation cycle and guarantees high path accuracy of the robot as well as external axes even during synchronous operation with high processing speeds. Up to 16 digital servos can be connected in the controller. The axes are driven and regulated by the servos which are connected to the CPU via CAN interface. The controller offers a lot of standard industrial interfaces for the communication with other machines. Excellent operation and programmability should be features of the Controller unit.

Programming the Robot using the Teach Pendent

The teach pendant should be a touch-sensitive operating surface (touch screen) and also a user-friendly interface between “human being and machine” which is easy to learn on the one hand. On
the other hand the operating system CAROLA provides the necessary support to the operators and programmers enabling them to carry out the programming work quickly and easily.

Advantages and benefits for the user:
- Multiprocessor system
- Separate digital drive control
- Modular design due to use of standard components
- Teach pendant with touch-sensitive operating surface
- Operating system especially developed for welding

therefore:
→ quality is ensured due to short interpolation cycles which guarantee high path accuracy
→ robot reacts quickly to correction data of a seam tracking sensor
→ multitasking operating system
→ digital control of the robot axes guarantees trouble free, application-specific drive of the robot and external axes
→ all components have a long service life
→ modular design reduces downtime in case of maintenance work
→ considerable saving of time and costs due to quick generation of programs
→ user-friendly and intelligent menu guidance due to 8” colour display with a Microsoft Windows surface
→ functions are displayed by symbols, therefore the operator does not have to learn a programming language
→ easy to operate since the teach pendant has only 30 keys
→ inputs are carried out by tapping on the functions which appear on the display, therefore the entry of wrong commands is avoided
→ easy adaptation to varying welding tasks
→ welding parameters are entered by means of physical values
→ restart at the interruption point – with or without lap start – even after the controller was switched off
→ optimum communication between robot controller and welding machine
→ serial coupling of the QUINTO Profi (SD) welding machine enables complete programming of the welding machine via controller
→ quick and simple optimisation of welding parameters during the process

Technical data of the Controller:

Basic construction of the control cabinet
Closed industrial PC feed for central processor and special RISC processor. Direct connection possibility via bus system for an input/output function in the control cabinet.

User memory
1 MB battery buffered memory
Max. 64 programs at 9999 points per program

Safety technology according to EN 775
Operating modes / selection of operating modes. Independently working control computer in the axis calculator of the robot basis axis. Control routines of set and actual values.
Interfaces (according to demand)
- Printer connection
- Serial control for welding machines
- Analogue interface for welding machines
- Binary interface for welding machines
- LAN-Interface
- Coupling for sensor systems
- Field bus system: Profinbus-DP

Control of NC axes
- 1 digital drive system per freely programmable axis

Inputs/outputs for the user
- 1 block with 16 digital inputs and 16 digital outputs (max. 64) can be extended by further blocks with 16 inputs/outputs each (max. 64)
- blocks with 4 analogue outputs and 2 analogue inputs

Input/output medium – operation and programming
- Teach pendant with 8" colour display and touch-sensitive surface
- ASCII-keyboard can be put into the control cabinet.
- Backup via 3.5" floppy disk drive in 1.44 MB Format (HD)
- Operating panel is integrated in the robot controller.

Environmental conditions:
- Ambient temperature: +5 to +40°C
- Air humidity: 10 – 80% in case of tolerances additional measures can be taken
- Type of protection: IP 54 in case of closed keyboard flap
Controller Unit

1. Working hour meter
2. Computer rack
3. Application bus
Components In PC Computer System

The Central Processing Unit

Function

The CPU component is responsible for the process guide of the complete robot system, which includes:

- Control of the PC bus
- Administration of the system and user memory
- Control of programming elements
- Managing of the ROTROL® operating system
- Coordination of up to 12 freely programmable axes

Features of performance

- 32-bit processor with integrated arithmetic processor
- 8 MByte (can be plugged) dynamic memory
- 100 MHz pulse frequency
- Direct connection for floppy disc and hard disc
- Direct connection for printer
- System clock (real-time clock)
- 2 internal and 13 external interrupt inputs
Versions

SLOT CPU 486DX100

At the moment, 1 version of the CPU componentry is used.
The Interfacing Card

Function

The PCIF2 connects the PC computer system to:

- the teach pendant (PHG)
- the application bus control (MCAN)
- the supply module
- the RDW
- the post code display
- (Laser sensor - option) and
- (the welding machine - option in case of serial control Quinto SD)

Characteristic features

PC circuit part
16 Bit ISA interface, data and address lines decoupled by bus drivers
complete logic implementation in EPLD, programmable In-System
NE2000 compatible Ethernet-LAN interface with link and activity LED
2 serial potential-free RS422 interfaces with je 64Byte sending and receiving FIFO each
SIMM-72 memory interface for PCM3 memory module
Interface for POST Code Display
2 re-readable, watchdog and tension-controlled safety relays for power release
2 dig. inputs for fan downtime monitoring
2 potential-free dig. inputs 5 – 50 V DC
8Kx16 Bit Dual Port Memory
State watchdog re-readable by PC and μC

Micro controller circuit part
C167CS 16Bit – Micro controller
Micro controller supervisor with tension monitoring and RESET generation
RS232 interface for diagnosis and download of the C167CR
256KB FLASH/EPROM program memory
256KB SRAM memory 16Bit
Re-readable, watchdog and tension-controlled safety relay for power release
3 potential-separated CAN interfaces up to 1MBaud
Evaluation of 2 temperature sensors, 1x PCIF2, 1 x control cabinet
8Kx16 Bit Dual Port Memory
serial TTL interface
4 state LED
Memory Modules

Function

The memory component PCM3 will be used as working memory/programming memory for the ROTROL controller. This memory is buffered by battery and can be plugged to a new PCI-F2 when changing the componentry.

Characteristic features

8 MB Flash memory for operating system and ROTROL-SW
1 MB battery-buffered CMOS-SRAM for robot user programs
128 KB FLASH for Cloos Extended Elcos and machine data
automatic switch-over of the CMOS supply tension
Battery Freshness Seal (J1)
Assembly in SIMM-72 socle

Front side

Memory buffer
Rechargeable lithium battery

Back side

Memory interface SIMM 72 poles
!Not compatible with PS2 DRAM!
Servo Controller Unit

The servo controller controls the motor unit by current supply to the motor with simultaneous selection and transformation of the resolver signals. Because of the differences in power, the robot axes and so the servo controllers are divided in categories being determined by:

> Robot type + axis number <

<table>
<thead>
<tr>
<th>Romat 320/350</th>
<th>Axis 1,2</th>
<th>E03DA113C4B551XXVC06</th>
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<tbody>
<tr>
<td>Romat 320/350</td>
<td>Axis 3 - 6</td>
<td>E03DA222C4B551XXVC06</td>
</tr>
</tbody>
</table>

Control

The servo controllers are mainly controlled from the supply module. Besides, the switching signals such as STOP/AUTO/ or Release (FG/LFRG) are forwarded from the distribution board to the servos. The brakes are controlled from the supply module. The servo gets the position information directly from the resolver which is monitored in addition by means of RDW.

Regulating step

The controller sends the set values for position and speed to the servo controller. They are led to the current regulator via comparison of set value/actual value and used for the control of the pulse-width modulation for the current supply of the motor.
The Other Accessories Of A Digital Robot

Sensor systems of Robot :-
1. Arc Seam Sensor
2. Gas Nozzle Sensor
3. Laser Distance Sensor
4. Arc Seam Sensor

The arc sensor reacts on workpiece tolerances quickly, exactly and dynamically. The measuring position of the sensor is located in the oscillating arc. The measuring values taken from the welding current enable an exact analysis of the welding torch position. The welding torch is moved by the robot. This analysis shows correction values for position changes in the directions right/left to the weld track and for the distance of the welding torch. The direct coupling of the arc sensor to the main computer allows direct position correction without restricting other functions of the robot.

Applications:
→ Tracking of a weld seam during MAG welding
→ Height correction during TIG welding
→ Height correction during Plasma cutting

Weld types:
→ Fillet weld
→ V weld
→ Y weld

Arc types:
→ Short arc
→ Spray arc
→ Pulsed arc

Material:
→ Steel
Technical data:

- Weld current range: 90 to 500 Ampere
- Min. edge height: 5 mm

Advantages and benefits for the end user:

- **Compensation of workpiece tolerance**
  → Optimum processing quality
  → Less investment in expensive workpiece supports
- **Simultaneous search and operation**
  → Search routine has no effect on cycle time
  → Determination and compensation of workpiece changes which are caused by the operating process (e.g. due to heat influence)
- **Restart after interruptions**
  → Restart of the search routine at the current position even after weld interruption because of emergency stop or arc monitoring
- **No restrictions due to mounting parts**
  → Accessibility and flexibility of the robot are not restricted
- **Dynamic adaptation of the correction sensitivity**
  → Application-specific reaction of the robot with regard to the size of the deviations
- **„Seam Memory Function“**
  → Stores the determined tolerances for subsequent operations (e.g. cover passes)

Measurement:

The measurement is based on the change of the weld current in case of different wire end lengths (arc resistance). The welding torch must carry out an oscillating movement for seam tracking. The current consumption value is taken from the summit of the movement. The computer stores the measured values. The comparison of these values causes the following reactions:

- \( I_{\text{right}} = I_{\text{left}} \) no correction
- \( I_{\text{right}} < I_{\text{left}} \) correction to the left
- \( I_{\text{right}} > I_{\text{left}} \) correction to the right

A set value which was adjusted by the operator during programming serves as reference for height scanning. The current value arises from the sum of the currents \( I_{\text{right}} \) and \( I_{\text{left}} \).

- \( I_{\text{right}} + I_{\text{left}} = \) Height set value no correction
- \( I_{\text{right}} + I_{\text{left}} < \) Height set value correction down
- \( I_{\text{right}} + I_{\text{left}} > \) Height set value correction up
Gas Nozzle Sensor

The weld start position can vary. Material tolerances or workpiece distortions which occur during welding by heat supply are two of many reasons. A robot equipped with a touch sensor is able to find out the weld start position before processing start. A metallic tooling part or a tracer pin which is located at the tooling is used as measuring device. Thus the sensor can be used in the whole robot working area without restricting its flexibility and accessibility. The search routines are carried out near the weld start on the surface and at the edges of the workpiece. The robot executes up to 3 search routines depending on direction and size of the tolerance in order to analyse the difference between the workpiece to be welded and the positions stored in the robot controller. The robot approaches the workpiece from 3 directions (X, Y, Z coordinates) to achieve exact measuring results.

Applications:

→ Recognition of the workpiece position  
→ Search of the process start  
→ Search of start and end of a straight-lined processing line  
→ Recognition of the weld seam volume

Touch points for the MIG/MAG torch sensor:

→ Gas nozzle  
→ Welding wire

Touch points for other tooling:

→ A tracer pin on the tooling or on the tooling bracket  
→ Contact surface on tooling

Materials:

→ All materials with electro-conductive surface

Technical data data:

| Contact voltage standard: | 60 Volt |
| Measuring accuracy: | ± 1/10 mm |

Advantages and benefits for the end user:

• **Compensation of workpiece tolerances**  
→ By finding out the tolerance at seam start and seam end a complete straight-lined processing line can be adopted.  
→ No investments in expensive clamping fixtures

• **No restrictions due to mounting parts**  
→ Accessibility and flexibility of the robot are not restricted

• **Increase of productivity**  
→ The range of workpieces to be processed with the robot system is increased

Measurement:

The search routine consists of one straight line. The robot with activated sensor moves for example the gas nozzle in workpiece direction. If the gas nozzle touches the workpiece, the robot stops its search movement and stores the current position. It carries out up to three search routines to scan the height, width and depth of the workpiece position. Based on the achieved measuring results the robot controller calculates a vector containing size and direction of the tolerance. When the robot controller adds the vector to the programmed positions (points) the achieved measuring results will be transmitted by the gas nozzle sensor. Processing takes place at the right workpiece positions without quality loss.
Robot Laser Sensor - Seam Explorer CSE

The CSE robot laser sensor is an offline sensor and consists of a laser head being mounted on the robot mounting flange and a computer located in the robot controller. The CSE determines the workpiece position before the process starts. The robot reacts to the measuring results from the sensor by adapting the travelling distance and changing the process parameters.

**Applications:**

- Search seam start
- Search seam end
- Detection of workpiece edges
- Recognition of lap joints
- Position determination of tubes and bolts
- Measurement of gap widths

**Workpiece surfaces:**

- Structural steel
- Steel zinc coated
- Galvanised steel
- Organically coated plates
- Aluminium
- Chrome-Nickel

**Weld types:**

- Lap joint
- Multi overlap weld
- Butt joint
- Joint with air gap
- Corner
- Fillet weld
- Single-bevel butt weld
- Tube and bolt joints

**Technical data:**

- Measuring distance: 100 mm stand-off
- Measuring range: +/- 40 mm of stand-off
- Resolution: 16 µm
- Reaction time: 2.5 ms
- Seam tracking speed: approx. 300 cm/min
- Laser power: max. 1 mW
- Laser beam diameter: 0.1 mm
- Laser protection class: 2 acc. to EN60825-1
- Spectral range: 400..700 nm
- Ambient temperature: 0..50°C
- Air humidity: 35..80%
Advantages and benefits:

- **High seam tracking speed**
  → Search routine has little effect on cycle time
- **Seam tracking without contact with the workpiece**
  → The use of the sensor to a large extent does not depend on the material
  → Coatings and workpiece impurities do not give incorrect measurements
- **Determination of gap width**
  → Adaptation of the process parameters to differing gap widths
  → Less rework due to optimum adaptation of the weld metal deposition to the measured gap width
  → Varying gap widths do not affect the appearance and the quality of the weld seam
- **Recognition of numerous seam forms**
  → Wide range of application guarantees a high flexibility of the robot system
- **Special input mode for programming**
  → Low time required during programming phase

**Function**
The material surface reflects a light beam which was sent by the sensor at a defined angle. When the sensor distance is within its working range, a light-sensitive element receives the reflected light beam and recognises the distance of the sensor to the workpiece on the basis of its entrance angle.

**Measurement**
- The robot moves to the start of the seam tracking section.
- The sensor is activated.
- The robot moves the sensor along the programmed tracking section.
- During this movement the computer on the sensor head stores the measuring value every 5 mS.
- The sensor is deactivated at the end of the tracking section.
After the measurement the robot starts operating or begins another seam tracking procedure.

The spot where the reflecting ray meets, determines the distance between laser and workpiece
Analysis of the measuring results

The computer strings together the measuring values that were stored during seam tracking, so that a two-dimensional image of the measured workpiece surface is created. A comparison of this image with a surface image saved during programming as a reference shows the corrections necessary to obtain an optimum processing result.

Reactions
- Adaptation of a complete program or a part of the program to the measured values
- Change in a processing section on the basis of the measured workpiece tolerances
- Change in the process parameters (speed, weld current, …)

Replace System for CSE Sensor

Technical description:

To exchange the tool at the robot system means first of all a considerable increase of the utilization ratio of a system. It does not make any difference whether similar or different processing methods are applied alternately. Thus different welding methods such as TIG, MIG/MAG or TANDEM as well as laser sensors can be used in sequence at one or different workpieces. But also the change to a gripper for parts to be tack welded, a bolt welding device, a gripper or a plasma cutting torch are already versions which are used in many cases. You can integrate as many tools as you like into the robot system. All tools which are suitable for the robot can be coupled automatically so that the tool combination considerably extends the range of workpieces to be processed resp. the working steps per workpiece. A loading station per tool and the coupling module mounted at the robot flange make the change possible. Outstanding features of the precise, pneumatically actuated clamping process are working reliability as well as an excellent repeatability. A pneumatic locking protects the loaded tools in the loading station and makes them resistant to power influences and vibrations. After loading of the tool only the clamping device remains at the robot flange. A plug connection realizes the identification of the loaded tool.

If the robot controller sets a certain output, it receives a specific signal for the tool on certain inputs. This test which is carried out before processing ensures that program and tool are matching. Thus damages at the tool and workpiece are avoided.

Advantages and benefits for the user:

- Different processes with one robot system
- Change is effected automatically

therefore:

→ increased utilization ratio of the robot system as many different processes can be used,
→ increased flexibility of the system, as the quantity of the workpieces which can be processed is increased,
→ exchange process is effected without time-consuming manual interventions
→ No additional set-up times as the fixture remains in the same device and system during procedure change,
→ The use of different welding processes which are adapted to the respective task increases the quantity of the seams to be welded
**Anti-Collision Sensor**

Collision protection for Robot mechanics and torch
Safety Devices

Workplace or Shutdown Monitoring

The safety limits switches on the Robot axes are installed according to the special requirements and guarantee personal protection when crossing welding stations.

Safety Devices on the Peripheral Equipment

The peripheral safety device on a system consists of various measures to protect operators, programmers and service staff.

This includes adequately high safety guarding probably provided with light protection panel.

Maintenance Doors :

“Emergency Off” is activated if a maintenance door is opened during operation mode automatic.

Safety Doors :

Auto protection when entering a welding station during work process.
Swing Doors & Light Barriers

Swing Doors:

“Emergency Off” is activated if a swing door is opened during operation mode automatic.

Light Barriers (3 Beams):

Light barriers are activated by pressing the start pre-selectors. The start pre-selection becomes invalid in all operation modes when then welding station is entered.

Emergency Off is released in the operation mode.

Thus for an overall period of time the robot must give an excellent output with satisfied customers and having no complaint.
Applications

Robot is used for welding purposes in different industries for faster production with consistent quality.

• It is suitable to perform various types of welding, such as :-
  
  - TIG Welding (Tungsten Inert Gas Welding)
  - MIG Welding (Metal Inert Gas Welding)
  - Tandem Welding (Twin Wire MIG welding)
  - Plasma Welding And Cutting
  - Spot Welding
  - Laser Hybrid MIG Welding, etc

• The welding process is dependent upon the materials
SAFETY REGULATIONS

Robots are designed according to the safety standard EN-775. The technical safety requirements for the construction equipment and operation of Industrial Robots.

Safety Precautions are in three modes

1. Safety Precautions in Slow Speed Mode

   - If possible, avoid entering the Robot operation area when the arm power is “ON”.
   - When initiating movement processes, ensure that there is no one in the Robot working area.
   - Continual observation of the Robot is necessary to prevent possible collisions in event of faulty operation.

2. Safety Precautions in Automatic Mode

   - Before switching on the drives, ensure that the guarding emergency are working properly and that there is no – one inside the enclosure or in the Robot working area.
   - Actuation of the safety guarding must activate and safety devices during Automatic operation and cause an Emergency Stop of the Robot. Safety guarding may not be switched off.

3. Safety Precaution while Maintenance and Repair Work

   - Carry out maintenance and repair work on the Robot only when the drives are switched off.
   - The Robot system must be protected from being switched on again by selection of the operational mode “OFF” and locking the operation mode selector switch.
   - When releasing the mechanical connection between drive unit and robot axis, it must be ensured that the brakes which prevent the robot axes dropping, are contained in this unit.
   - By releasing the mechanical connection, the breaking effect is made inoperative.
Safety Precautions Methods

When the work piece is loaded, the operator activates the start pre-election button.
1. Safety equipment at the workplace is activated.
2. The safety equipment is deactivated as soon as the robot has terminated its working process and left the working place.

Benefits:-

1. Optimum protection of the operating personnel.
2. Safety equipment is automatically deactivated when the working process is finished when the Robot has left the working place.

Advantages

Advantages and benefits of Robot for the enduser :-

- Robust construction
- Optimum dynamics with a high accuracy
- Slim and compact design
- Digital AC-drive technology
- Absolute path measuring system
- Large hemispherical working range

Advantages and benefits of the Controller Unit :-

- Multiprocessor system
- Separate digital controller
- Modular design due to use of standard components
- Teach pendant with touch – sensitive operating surface
- Operating system developed for welding purposes

Advantages and benefits of the Arc Sensor and Gas Nozzle Touch Sensor :-

- Compensation of work piece tolerance leading to optimum processing quality and less investment in expensive work piece support.
- Simultaneous search and operation because search routine has no effect on cycle time. Determination and compensation of work piece changes which are caused by the operating process due to heat influences.
Restart after an interruption which helps in restart of the search routine at the current position even after weld interpolation because of emergency stop or arc monitoring.

No restrictions due to mounting pats hence accessibility and flexibility of the robot are not restricted.

Dynamic adaptation of the correction sensitivity resulting in application specific reaction of the robot with regard to the size of deviation.

Seam memory function helps in storing the determined tolerances for subsequent operations.

**Advantages and benefits of the Torch Cleaning**

- Reduction of downtime
- Long service lives of the welding torch components
- Gas nozzle as sprayed with anti adhesive spray
- Manual operation is no longer required

**References :-**


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