IMPROVING THE QUALITY BY AUTOMATIC ASSEMBLY

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REZUMAT. În producţia de bunuri se cere tot mai mult ca acestea să fie de calitate şi la preţ de cost cât mai scăzut. Acest deziderat poate fi realizat prin introducerea asamblării automate a produselor. În lucrare se analizează tipurile de asamblare şi funcţiile care trebuiesc îndeplinite în cadrul unei asamblări automate. Introducerea asamblării automate a produselor va avea implicaţii şi asupra concepţiei produsului, fiind necesare unele modificări pentru a fi posibilă asamblarea automată.

Cuvinte cheie: asamblare, automatizare, cost, funcţii.

ABSTRACT. In product manufacturing there is a great necessity for the quality and the low cost. This can be improving by introduction of automatic assembly of the products. In the paper are analyzed the different types of the assembly and the functions that must be implement in this automatic assembly of the products. By using automatic assembly of the products the design of the products must be change for creating the possibility to introduce automatic assembly.

Keywords: assembly, automatic, cost, functions.

1. AUTOMATIC ASSEMBLY NECESITY

Now the good production asks increasing costs that make more attractive automatic assembly. Using this assembly can be made economy for operator labor. The management is interested in: indirect manufacturing cost, quality with all implication for warranty and reliability, the market request, the time till the product appear on the market, reducing of the inventory and the operator's protection. All of these can be improved by introduction of the mechanization and automatic assembly.

Automation is a very productive method. It is relative expensive and assume some risk of the investment. The highest application of it is in automotive industry, electronic industry etc. The automation is applied for great series and mass production, where are assembled many similar parts or parts of the same product family, when the assembly sequences are similar (see fig. 1).

Sometimes can be applied automatic assembly even than the annual production not so great. It can be applied for products with high request for quality or products with a great seasonal requirement.

Automatic assembly has some implications upon manufacturing process of assembly parts. In this case is imposing a greater capability of the manufacturing processes, an improvement of the quality control and a better conformation with manufacturing scheduling.

Fig. 1. Parts use for automatic assembly.

2. ECONOMIC BASES OF AUTOMATIC ASSEMBLY

The engineer has the task to select the equipments for product assembly. He will indicate the technical requirements for the equipment and will recommend the possible sources for them supply. These equipments costs and they must be recovered in more short time. This is the reason for which the buying of the equipments for automatic assembly is a task for the management. The equipments that were been buy must worth the invested money.

Automatic assembly is a manufacturing method that can improve two mining elements: the productivity of the assembly and quality of the product.

Because the return is the final objective, always must take in consideration the winning of the new markets for the products. The companies which have many markets for them products are more profitable for the others that have a small market sheering. It is proved that the market sheering and the rate of pay off have a strong correlation [1]. That can be seen in figure 2. In figure can be observe that the rate of pay off for the products with a great market sheering is sensible greater than of products with smaller market sheering. Because the correlation between rate of pay off and market sheering is linear and the increase of the return is more greater (exponential), result a great advantage to increase the market sheering.

The problem is haw a company can win new market. The response is by publicity, good quality of the products, better knowing of the market requirements and fast adapting at these market requirements. The companies that will understand to fabricate “more, better and cheaper” will stand.

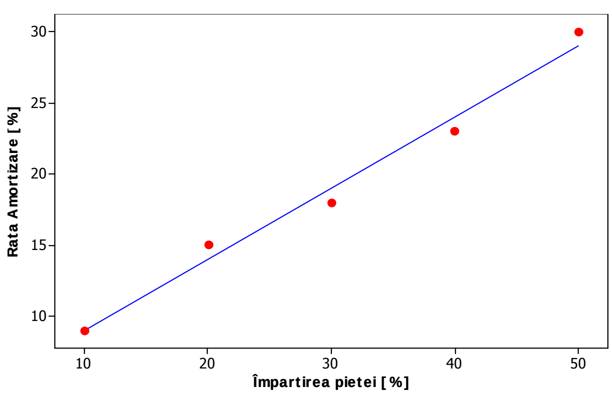


Fig. 2. The relation between pay off rate and market sheering.

3. COST REDUCING

Reducing of the costs is always in actuality, it is good also in the case of assembly. Reducing the direct costs is an important objective, but not alone. Can be reducing and the indirect costs, like: costs with control operators, supervisors, financial staff and inspectors. Bu introducing the automatic assembly, with a very good scheduling of them, can be substantial reduce the number of the assembly equipments. Due to a high assembly capacity, in the case of automatic assembly, the manufacturing sector can conserve the inventory at the small and reasonable levels.

More can economize by making a uniform quality of the assembly, reducing the problems with product reliability and the rework for warranty and generally an increasing of company efficiency. These entire justified introduction of the mechanize or automatic assembly.

4. TIPURI DE ASAMBLĂRI

There are two types of assembly:

- additive assembly (series assembly);
- multiple insertion assembly (parallel assembly);
- mixed assembly.

Additive assembly (series assembly). In this type of the assembly a series of the components are add, in a specific sequence, on the assembly. Failure to insert any component or failure to place components in proper sequence and in proper physical relation ship to other components means that product is defective immediately.

If the assembly process will continue cannot be obtain a benefic effects. Examples of these additive assemblies are: automotive thermostats, audio cassettes, cigarette lighters and retractable ball-point pens (see fig. 3).

Fig. 3. Aditive assembly

This type of assembly may or may not include the ultimate housing or base of assembly product. Often, good product design will allow a series of sub-assemblies that are later installed into final assembly.

It is in the nature of such additive assembly that some assembly system control decision must be made once the assembly equipment detects any failure to properly insert of components. It is sufficient to re-cognize that in additive assembly, failure to insert any component in proper position, relative to other components means that assembly sequence should be stop, until some form of corrective action has taken place. Will be taken corrective actions for the case of misplace or missing part piece. The missing part may be replaced on the machine by manual techniques; it can be handled by continuing to move the defective, incomplete assembly through subsequent stations on the assembly system, while station down-stream of the failure lock out automatically so no value is added to the incomplete assembly. At the end of the assembly line this incomplete assembly will be eject.

More complex and expensive control technology was required for this option. Other solution is to have the machine attendant immediately remove the incompletely assembly at the point of incompletely condition is detected and manually replace it with a good subassembly complete to the point so that machine can be restored to full automatic operation.

There are three design corollaries in additive product design [1]:

– assembly should be design to facilitate the monitoring of the assembly process as it occurs in each incremental step of the machine sequence;

– access should be provided in the design for sensors to determinate presence and correct relative position of each component immediately after each insertion or joining operation;

– reference locations or surfaces should be included in the assembly design whenever insert components have less thickness or size than possible height stack up of dimensional tolerance in parts previously assembled.

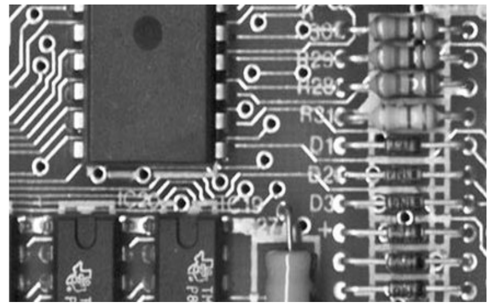
Assembly should be so designed that easy manual or automatic removal of the incomplete assembly is practical. Often sees assembly that can be easy ejected from the assembly fixture only when the assembly is full complete.

Wherever practical, product design practice should eliminate the necessity to insert fasteners and join in the same station. Repair and salvage potential is often enhanced if insertion and joining operations are isolated. Only in that way is it practical to detect relative parts' presence before attempting joining.

Multiple insertion assembly. A multiple insertion assembly is one in which a series of discrete parts not touching one another are assembled in different locations on a common base, but the success or failure of any insertion or joining operation will have no direct effect on other subsequent inserting operations. Typical multiple base insertions would include circuit board with axial lead or surface mount components (SMT), vacuum tube sockets and similar objects. Examples of multiple insertion assembly are presented in figure 4.

The machine design implications of multiple insertion type products are enormous. If each of the components inserted on the product base is different in shape and configuration, the basic assembly system need not be much different that the designed for additive assemblies.

When a common or identical component is repeated inserted in a multitude of locations, annual volume requirement will have much to do with machine selection. If the required product is low, a positioning table indexing in two or more axis under a single station inserting head is most practical. When production requirement are higher it may be necessary to do a series of inserting operation concurrently, often by means of redundant (or multiple) tooling. In these cases the cost increases rapidly (exponential).



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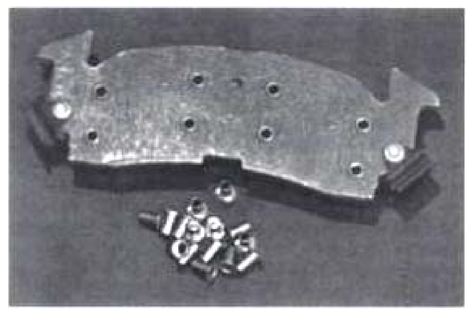

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Fig. 4. Multiple insertion assembly.

Multiple insertion products can be designed so that off line salvage of assembly with one or more missing components or with a defective joint operation can be done by hand or by simple single station equipment. Since the failure of any given insertion operation does not affect the quality of subsequence operations, simple inexpensive salvage eliminates the need to lock out downstream operations after an indication of failure at a preceding station.

When high production volumes indicate concurrent insertion at multiple redundant stations, much thought should be given to kipping pitch or part location large enough to provide for insert tools and so the assembly process is not stopping.

Mixed assembly. This type of assembly combines the additive and multiple insertion assembly. Fervently one the first two type of assembling will be dominant. The dominant assembly, together with production volume will decide the choice of the most economical assembly system.

5. THE FUNCTIONS OF THE AUTOMATIC ASSEMBLY

For a good assembly of a product, the assembly equipment must achieve the following functions [2]:

- automatic feed with assembly components:
  - components ordering;
  - transfer in ordering condition towards assembly station;
  - brake and delivery in assembly space;
- insertion of assembly component:
  - component transport in desired position;
  - transfer in position properly for assembly;
  - right positioning of the components in assembly station;
- position preservation by joining:
  - demountable joining;
  - solid joining:
    - joining by plastic deformation:
      - riveting;
      - necking;
      - relieving;
    - welding;
    - soldering.
- inserarea componentelor în ansamblu în curs de realizare;
  - transportul componentelor în poziția impusă de asamblare până la locul de asamblare;
  - poziționarea corectă a componentelor în locul destinat ăn ansamblu;
- conservarea poziției componentului inserat prin fixarea sa:
  - fixare demontabilă (înşurubare);
  - fixare nedemontabilă;
    - fixare prin deformare plastică la rece:
      - nituire;
      - gâtuire;
      - reliefare;
    - sudare;
    - lipire.

These principal functions have a lot of auxiliary functions that must be achieve by the automatic assembly equipment.

The components ordering can be made with many ordering devices. In figure 5 is presented the vibratory feeder for assembly components ordering.

In vibratory box feeder are put the parts in disordered state, which will be ordering by vibratory movement of the feeder. After them will be collected by a tube and will be transferred in desired position to the assembly station.

The assembly of the components will be made using rotary assembly machine (see fig. 6a), or using lineal assembly machine (see fig. 6.b) [3].

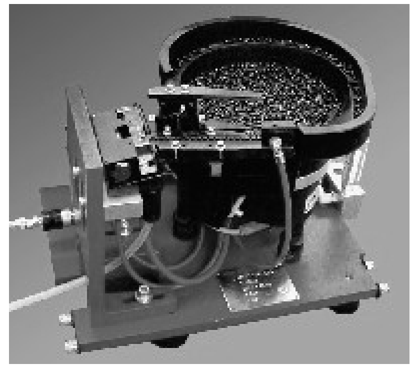
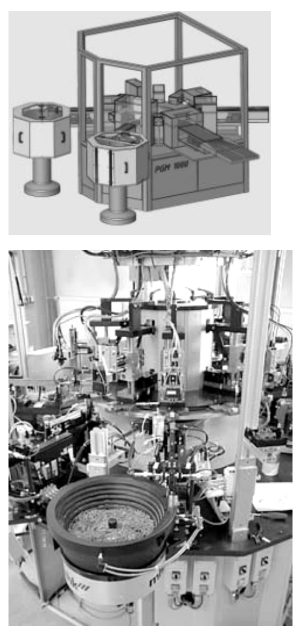


Fig. 5. Vibratory feeder.

In the case of rotary machine the number of assembly station is limited, but for lineal assembly machine the number of assembly station can be greater, according with the needs.

After the components will be inserted on the assembly, they must be joining on the assembly, using one of the functions of the automatic assembly give before. In figure 7 is presented the case of joining using screwing [4].



a) b)

Fig. 6. Rotary and lineal assembly machine.

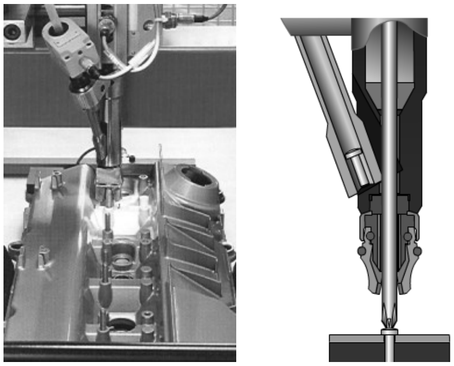


Fig. 7. Joining by screwing.

6. CONCLUSIONS

For introducing automatic assembly must be made some adjustment in the design of the products. So, the assembly components may be design for a minimum number of insertion planes for them assembly. The design of the components must take in consideration the ordering possibility of the components. This ordering must be made easy using usual feeders.

In the case of automatic assembly must be made adjustments for parts joining in assembly. In automatic assembly must be avoiding the joining methods that need long time during fastening. Otherwise this fastening will be very difficult to do or even impossible. In the cases of long time for fastening, the balance among assembly station is difficult to do.

All these improvements impose by the automatic assembly; will have like effect the increase of the assembly capability, the increase of economical effiiency and final the increase of product quality. The increase of quality can be made also by improving the product design, but more by increase of the assembly consistently by using the automatic assembly.

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