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Special Machinery reduce the Cost of Production

Des machines spéciales réduisent les frais de production

Spezialmaschinen reduzieren die Herstellungskosten

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1.1 - Introduction

Mass production needs adequate plants, particulary machinery and advanced methods in respect of the standard machines normally used in making prototypes (or small and very small series). It is possible for any structural part to lay-down a couple of curves defining the areas of work-convenience according to one of the two methods, i.e. "standard" or "series", always as functions of the quantities to be fabricated: so, it is possible to visualize, by numbers, the notions of "small" and "large" series. The figures refer to production with existing machinery.

1.2 - Explanatory notes to the figures

"Figure" 1 shows the total working time for increasing quantities of the same item. The piece is an angle-bar L 60x60x4 mm, 3700 mm long undergoing the following working stages: shearing, tracing, marking, punching. The table shows the tooling time (pieces = 0), the total time and the time per piece (including tooling) for mass production. The critical number n_c represents the number of pieces below which the use of conventional machines is convenient.

All the times given include displacement of the pieces, as well as of original bars.

The working times are also shown as the sum of two components: the time required for the displacement of pieces, and the time required by the actual processing free of tooling; both the times are indicated in percentage.

"Figure" 2 refers to an angle-bar L 130x130x9 mm, 7460 mm long for wich data as for "figure" 1 are given.

"Figure" 3 refers to an angle L 8"x8"x1" (203x203x25.4 mm), with drilling holes. Data as for 1 and 2 are given, considering also the use of a machine still conventional, but improved in perfomance.

"Figure" 4 shows the data as for 3, referred to a 300 HEB beam, 6260 mm long.

"Figure" 5 relates to a gusset plate, 280x12 mm, 400 mm long, with punched holes. The data given are as for 3.

2.1 - Guiding criteria for the choice of machinery and plants for mass production

A look at the individual times concerning the process of preparation leads to the distinction of such operations in two groups. The first covers these processes for wich the actual working time of the tool (shearing punching, etc.) is so

small that there is no particular interest in further reductions, since it would involve expensive and sophisticated machines: for this first group it would be advantageous to out down the times of displacing and positioning.

To the second group covers those operations for which it is predominant the working time of the tool, (drilling, flame cutting, milling); in this case it is important to reduce the working time of the tools (directly, by raising the driving power; indirectly, by increasing their number), as well as the time requested for displacing and positioning the pieces: in fact, an excessive reduction of the tool-time alone is ultimately unacceptable for the hig cost of the machinery involved and it is often technologically impossible.

In order to reduce the time for displacing and positioning the pieces one can resort to:

a) mechanize the placing in position;
b) coordinate all the machines of the cycle, by synchronizing their cadence;
c) carry-out two or more operations of the cycle with a single plant;
d) adopt advanced gripping devices;
e) use improved blocking devices;
f) adopt universal tools, mechanizing their replacement;
g) separate the loading and unloading places from the working ones.

For reducing the working time of the tool one can resort to:

h) increase the number of tools operating simultaneously;
i) raise the driving power;
j) increase the number of pieces simultaneously on the working line.

Referring now to the real cases of "mass production" mentioned in the "figures", it can be noted that:

Figure 1 - When applying the suggestions contained in points a),b),c),e),g),h),j), the working time for the same operations is reduced from 4.6 to 1.
Figure 2 - Points a),b),c),e),g),h),j), are applied and the time is reduced from 4 to 1.
Figure 3 - Considering the points a),b),e),h), the time is reduced from 1.6 to 1.
Figure 4 - The time is reduced from 2.1 to 1, when the suggestions given by points a),b),e),h), are taken into account;
Figure 5 - Considering h), the time is reduced from 2 to 1.

sample	a	b	c	d	e	f	g	h	j	l	efficiency	n_c
Figure 1 Series M	=	=	=		=		=	=		=	4.6	38
Figure 2 Series M	=	=	=		=		=	=		=	4.0	51
Figure 3 Series M	=	=			=			=			1.6	125
Figure 4 Series M	=	=			=			=			2.1	84
Figure 5 Series M								=			2.0	147
Figure 3 Impr.Stand.M	=		=	=	=	=	=				1.1	175
Figure 4 Impr.Stand.M	=		=	=	=	=	=				1.2	120
Figure 5 Impr.Stand.M					=	=					1.6	444

2.2 - Improved standard machines and their effects on the evaluation of the notion of "series"

In order to apply some of the above principles also to the manufacture of prototypes, proper modifications have been carried aut and there are machines and plants, on which we can now give the attribute of "improved standard". In detail, they take into account normally the suggestions in para a),e),f); in some cases, the principles c) and d); they do not realize the points b),h),j).

Since points b) and h) are qualifying for a mass production plant, it is clear that the improved standard machines of the present generation can in no way be classified among the machines for "series".

Referring once again to the real cases reported on the figures, for the manufacture on improved standard, it can be seen that:

Figure 3 - Suggestions a),c),d),e),f),g) are followed, and the working time is reduced from 1.15 to 1.
Figure 4 - Principles a),c),d),e),f),g) are applied. Time is reduced 1.2 to 1.
Figure 5 - Taking into account a),e),f) the time is reduced 1.6 to 1.

As far as the number n_c is concerned, its value for the cases under consideration is respectively for

Figure 3 from 125 to 175
Figure 4 from 84 to 120
Figure 5 from 147 to 444

confirming as could be reasonably expected that in the face of a higher efficiency of the standard methods, the critical number n_c rapidly increases, so that one can doubt, on the strenght of the elements so far submitted, the real convenience to designing and detailing for mass production in respect of a more free design, associated to a greatly improved standard fabrication. We can however affirm that the doubt is not well founded and that the assumption is substantially incorrect. In particular, for the case n° 5 "series" it can be understood from the summary table how the sole suggestion h) has lead to the realization of a machine absolutely unsatisfactory.

The value of n_c for efficient production must be kept considerably below 100.

3.1 - Efficiency of mass production

To obtain a real reduction of the overall manufacturing cost for structurals designed and detailed for mass fabrication, it is not sufficient to take advantage of suitable plants and machinery, but it is also necessary to benefit from a productive organization especially planned for the purpose.

On the contrary it is found that the benefit obtained on the machines are substantially defeated by the upkeep of an operative pattern sized for a conventional production. It is not rare to find that orders which can be processed for mass fabrication with an output efficiency of 4 to 1 have ultimately a fabrication cost of 2 to 1, in respect of conventional manufacture.

In the present stage of development of plants and organization tecnique it is possible to achieve a reduction in the production costs between 1/2 to 1/3 of the processing costs of equivalent articles not manufactured in series.

It is expected that such reduction could go as far as 1/4 and beyond for the projects under study, and bearing in mind the ever increasing incidence of personnel cost. Still greater reductions could be echieved in the production of typified structures (no longer by order, but for the stock).

3.2 - Conclusion

A substantial saving in production costs of steel structures is feasible if they are designed and detailed not necessarily in view of their minimum weight, but considering the minimum overall cost. Such saving can materialize provided the workshops are equipped and organized specifically for mass production on specific by orders.

SUMMARY

It is possible to establish certain basic characteristics of the machinery planned for mass production on specific orders. It is defined the efficiency value for operating on machines "series" in respect of standard machines and improved standard machines.

RESUME

Il est possible d'établir certaines caractéristiques de base pour machines destinées à la fabrication en masses, sur ordres déterminés. Le rendement est défini pour le travail sur machines "séries" comparées avec machines standardisées et machines standard perfectionnées.

ZUSAMMENFASSUNG

Es ist möglich, gewisse grundlegende Charakteristiken für einen Maschinenpark aufzustellen, der für Massenfertigung nach spezifischen Erfordernissen geplant ist. Der Nutzeffekt für die Arbeit an "Serien"-Maschinen wird hinsichtlich jenes an Normal-Maschinen und verbesserten Normalmaschinen definiert.

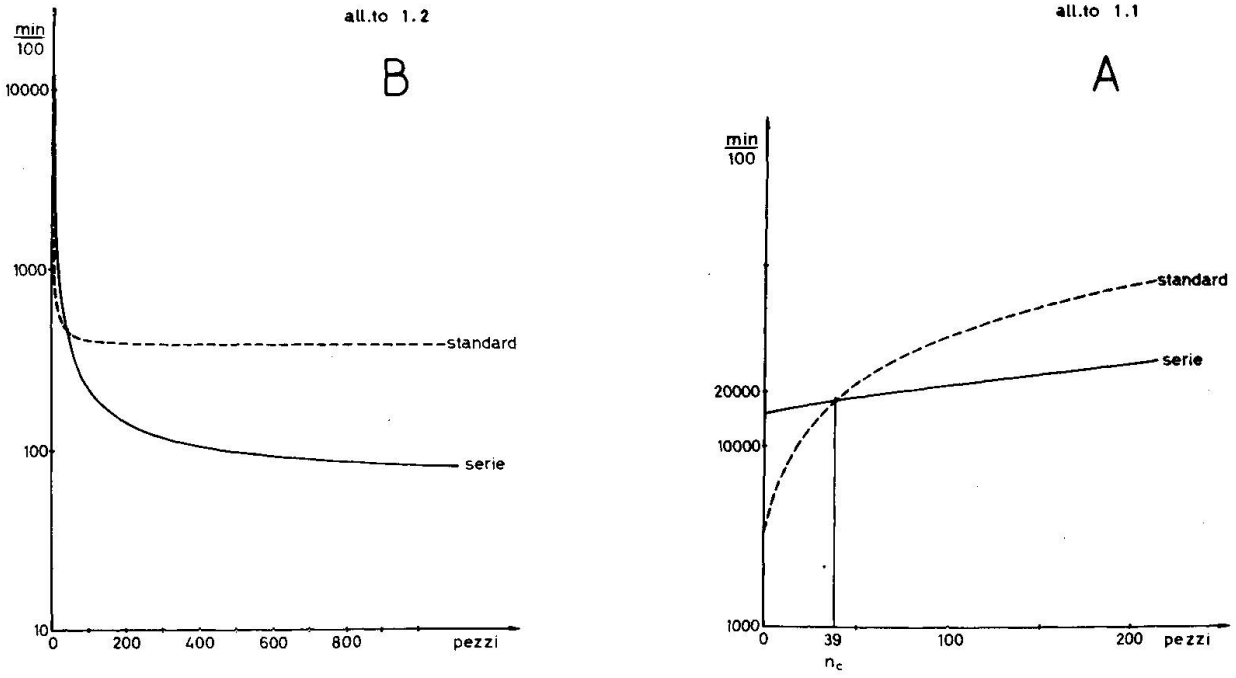

fig. 1

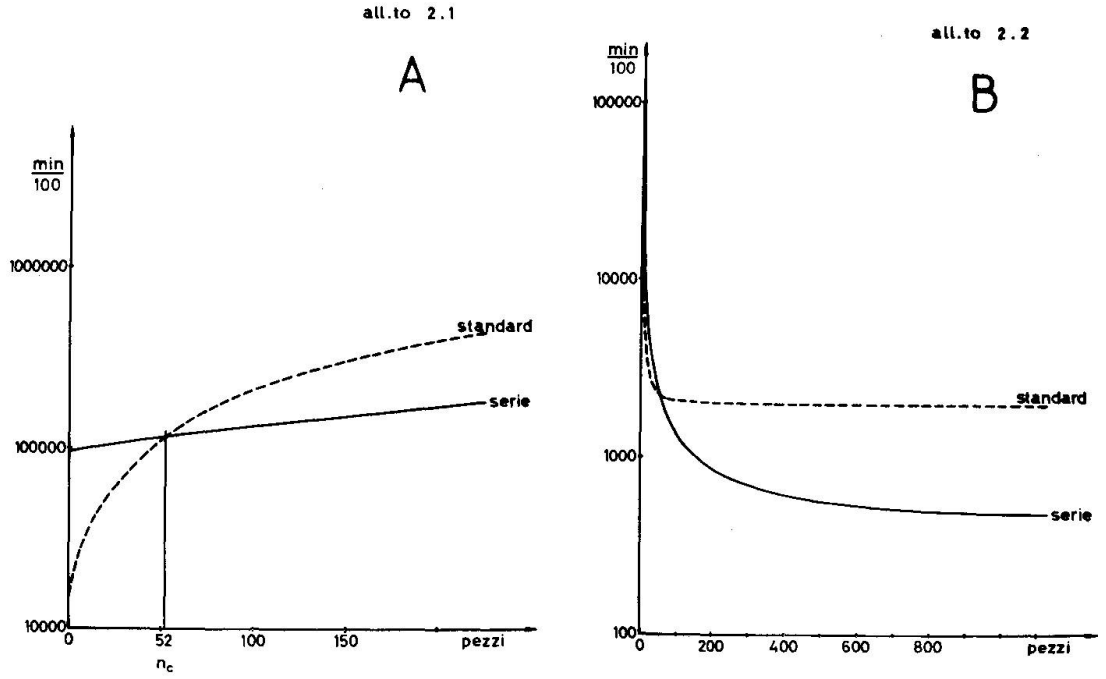
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fig. 2

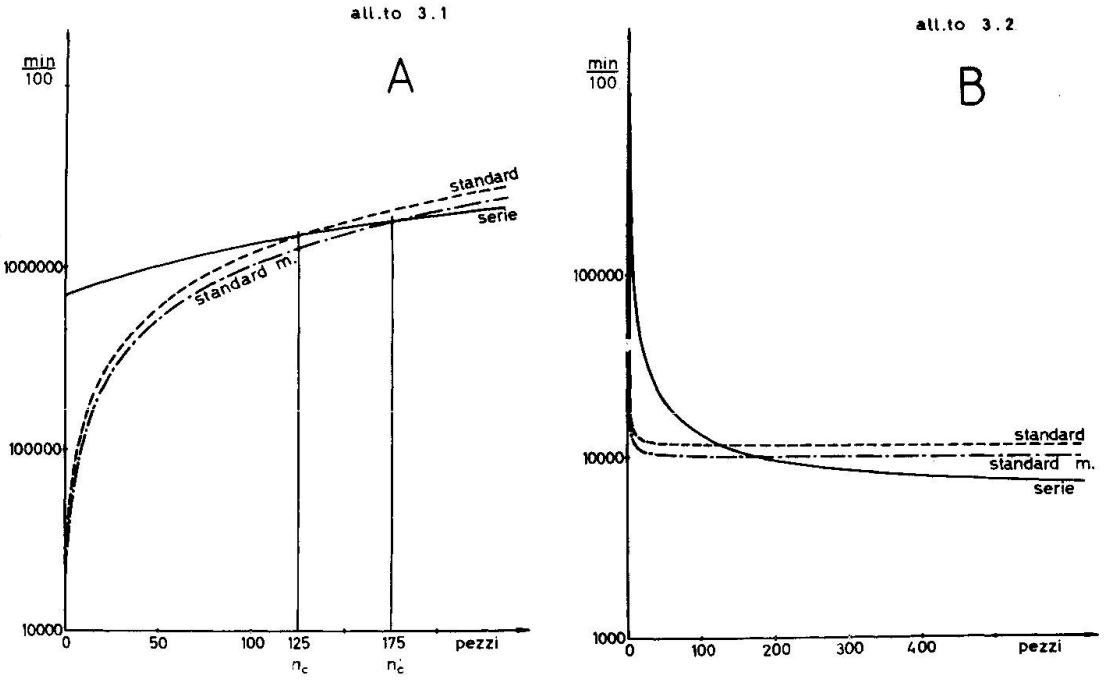
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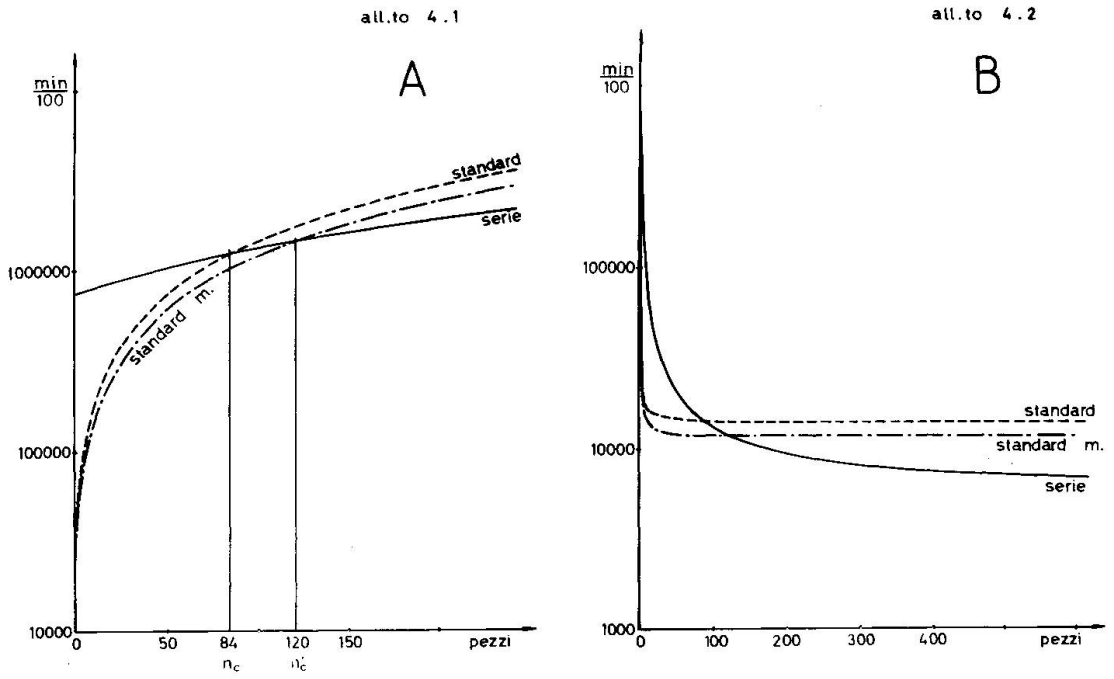
fig. 3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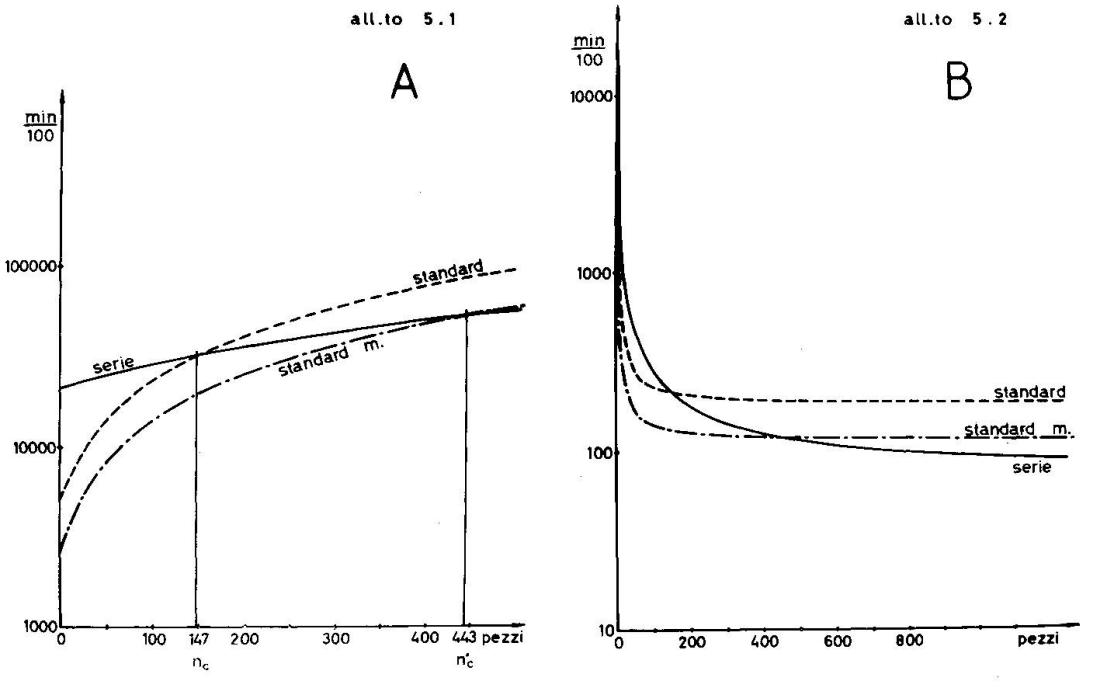
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fig. 5