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The Seminar on the Co[illegible] and Development
of the Automotive Industry in Developing Countries
Karlovy Vary, CSSR, 24 February - 14 March 1969

SOME ASPECTS OF AUTOMOBILE BODY BUILDING

by

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SOME ASPECTS OF AUTOMOBILE BODY BUILDING*/

by

Zdenek Kejval
Director, Body Building Dept.
Automobile Works
Mladá Boleslav
Czechoslovak Socialist Republic

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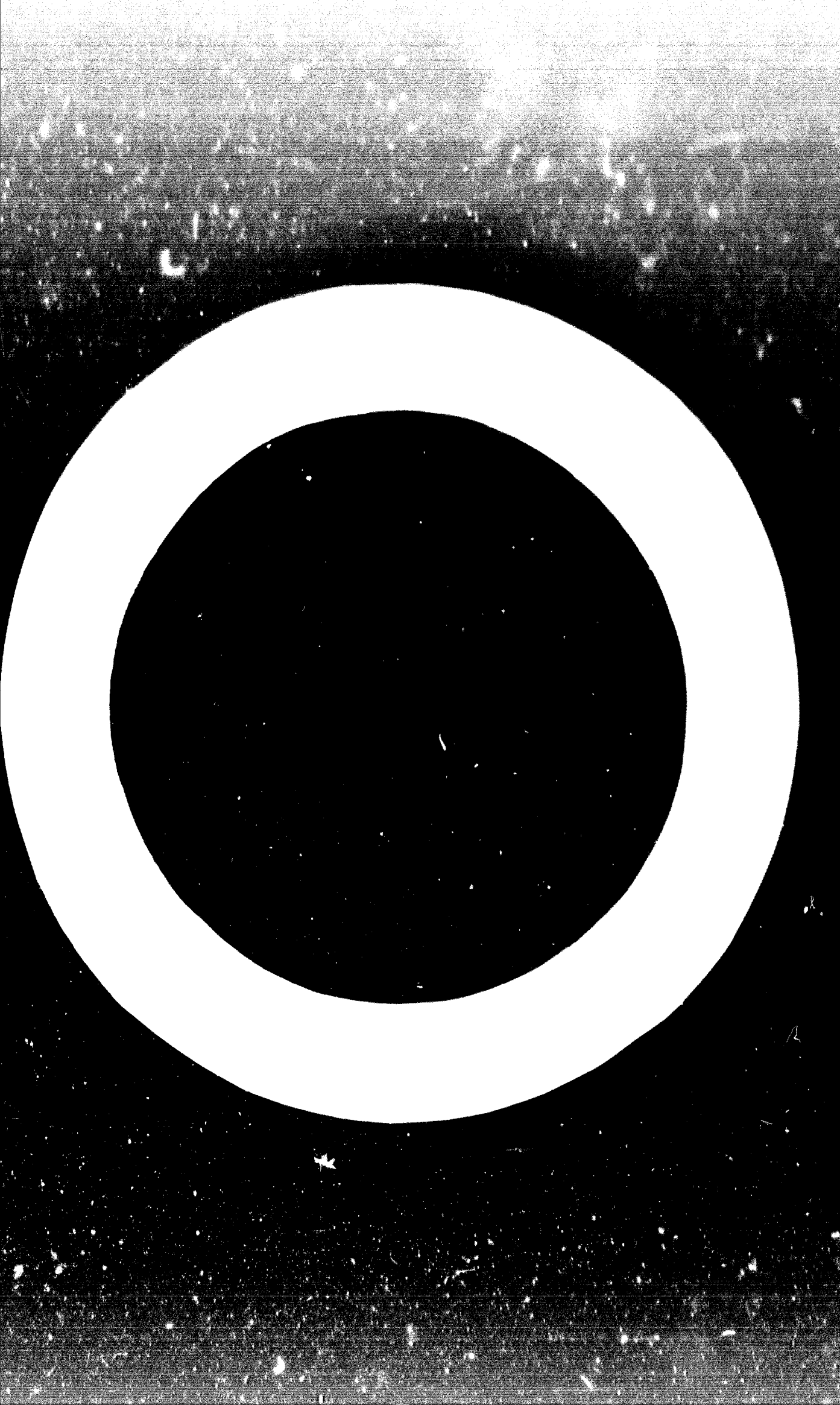

[illegible] Automobile Body Building

[illegible]

[illegible] development [illegible] to the transport, [illegible]

[illegible] automobile [illegible] development and production [illegible] production of automobiles [illegible] industrial [illegible]

[illegible]

[illegible] industrial [illegible] and [illegible] production [illegible] the bodies will be produced.

Bodies [illegible]

[illegible] and conditions [illegible] production of automobile bodies. Its content [illegible] the following chapters:

[illegible]

[illegible] Body Building

[illegible]

[illegible] of Types [illegible] and Volume of Production

[illegible] Production Level

[illegible] and Technological Changes

[illegible]

[illegible] of Technology

[illegible] Methods

[illegible]

[illegible] of Production

[illegible]

[illegible]

Surface Treatment

By Painting

By Metal [illegible]

[illegible]

Final assembling, Dispatching

4. Automobile Body Plants
   4.1 Present Situation
   4.2 Basic Principles
   4.3 Cooperation Among Body Manufactures

5. Conclusion

The chapter, "Effective Body Building" deals with all main factors influencing economic design and production. Individual factors are analysed in the respective paragraphs of this chapter.

The chapter, "Body Production" discusses all the technical trades which are needed for the production of all-metal bodies made of sheet steel. For each trade the main technological steps, necessary tools, devices and machines are specified, and the fundamentals of series and mass production is described.

The chapter, "Automobile Body Plants" involves a brief analysis of the present position of body plants in the production of automobiles, their arrangement and reasons for geographic location. Finally, some examples of relations among dispersed body plants of several European automobile factories are given.

Zdeněk K e j v a l

Director, Body Building Dept.
Automobile Works
Mladá Boleslav

[illegible]

[illegible]

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Table 1: [illegible] Paper

1. The agreement in series number of various modifications, expressed in [illegible] compared to the basic type
2. The series number of combination, expressed in the number of bodies produced
3. The technological body [illegible] layout
4. The technical [illegible] sequence of body surface finish
5. The standardized sequence of metal plating
6. The series number for particular body types

Introduction

An important condition of economic and social progress is [illegible] to which each may buy a substantial part of what he wants. Buy it at first, of course, and then, efficient and comfortable means of transport, even if [illegible] and other services, [illegible] significance, for instance, [illegible].

Even the simplest [illegible] of [illegible] consists of several thousand parts, in the production of which, not only the [illegible] to [illegible] parts, but also [illegible] branches of [illegible] metallurgical, engineering, rubber, textile and glass industry [illegible] depends on the degree of [illegible] and natural resources, in any and what types of [illegible] be used.

Cars may be made in different ways, starting by assembling them from imported parts or [illegible] make the country [illegible] self-sufficient. But, of course, in each case, it is necessary to take into [illegible] the economical points of view [illegible] and permanently profitable.

The [illegible] for investment protection and economical production make out of the [illegible] construction and development an intricate task and therefore the serious [illegible] action, especially of our bodies, is one of the most sophisticated engineering ones.

It asks for tackeling not only a lot of different technological processes and [illegible] of investments for equipping new methods of production and inevitable modifications, which, from time to time, must be carried out with respect to the market. Many making operations are in principal the same as for the complete cars, as it has been briefly stated by the American magazine Fortune; dealing with this problem as follows :

"For a plant to become a successful car maker, it is sufficient to fulfil simple conditions :

- first of all, to have a highly prosperous organization with people and equipment for making the cars,
- secondly, to have a car being worth while producing,
- and third, a further big organization for sale and maintenance.

As a body represents a substantial part of the car as a whole, the same can be applied in full for it.

In making decision what type of a car and body should be made, this, of course, can be determined after a thorough study of similar foreign designs, markets and own productional possibilities :

1. the required size, design and functional requirements;
2. the number of bodies made /and its series/ and costs for labour, material and running;
3. the total costs including proportions of new installation depreciations, tools and jigs for one respective body.

Another important condition for maintaining the expected costs under good working conditions, it is necessary to keep under review the first conception designs, After comparing and evaluating several variants, the best compromizing solution is chosen.

I. Effective Body Building

A body, as an integral part of a car, underwent a remarcable development and in its history, several stages of development can be noticed :

1. body is as a coach
2. compozitive body - wood and metal sheet
3. all-metal body
4. chassis-less body
5. body made of plastics, modern compozitive materials

In the course of this development, the design affected [illegible] logy, and, on the contrary, technology made possible new d[illegible] and increasing number of bodies made. The main principles of [illegible] fective body [illegible] modern design, economical and [illegible] production series harmony within the needs of [illegible] and consumers' [illegible] demand. All these principles appear [illegible] all its building [illegible] as follows:

1. basic design, choice of type and filling the basic and deriv[illegible] modifications;
2. material used;
3. number of types produced and series;
4. sale facilitation;
5. life time;
6. technology chosen;
7. technology and its level;
8. laboriousness;
9. production organization;
10. economic aspects.

Design

The design being a starting point for the production preparation, it has a far-reaching importance on the right choice of technology and substantial effect on sale. Along with the quality it is the first pre-requisite of successful production. But a question still remains how modern this design should be. It must not be or better should not be too much ahead-of-time, for it is running the risk of not being properly tested. The same applies to its shape and the risk of unfavourable buyers' response who are mostly more modest. It is chiefly the buyers' task which further influences the possible choice of types and models being sold on the market.

From the very start of production, bodies should meet the world standard and be saleable on the market for several years but, of course, with slight modifications which, now and then, are asked for. For this reason, certain modernizing elements should always be taken into consideration during its design.

As for cars and bodies, it is necessary to distinguish the so-called 'ahead-of-time and temporary values'.

These ahead-of-time values include :

- reliability and safety,
- comfort, that is, seats, space for getting in and out, ventilation, weather protection and outfit,
- economical run and maintenance,
- sufficient life time.

It is chiefly the shape, style, and, to a certain extent, material which must be added to these values. The ahead-of-time values can be applied for each body and period, and can be appreciated after a certain time of run only. The temporary values, especially, shape and style have a great influence on introducing a new type and together with colour, they very often oust the ahead-of-time values.

First of all, the design determines the building system /chassis or chassis-less body / the material used / steel-sheets, light alloy sheets or plastic panels/, body size and, according to the vehicle category, its outfit inside.

The design itself results in chosen technology which together with the number of cars produced, fixes the direct labour and the number of complicated tools, jigs, machinery and its proportion on body production cost. With respect to the clients' demand and competition, each type is being made on the basis of its layout /two-door or four-door, saloon/ and further derived modifications

[illegible] cost of the basic shuttle is the same as in the case of the basic type. The number of interfacing and different units is increased in the basic type as is seen in the following table. The table presents the [illegible] and [illegible] cost.

Table 1

Body type	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Material

Material represents a substantial part of body production costs, namely, 40 $ - 60 $. Therefore, it is the main task of design and technology to make the most economical use of material. There are about 10 - 15 different kinds of materials the body consists of and each requires special treatment. The material for framework and panels has the most decisive effect.

During the first development stage, the oldest method be-

wooden framework with wooden panels. Frameworks were glued by means of soaking, heavily cemented, dry surface was ground and varnished with a brush.

With the development of production and sheet processing, a composite body with a wooden metal-clad framework was developped. This second development stage was applied for a long time until the amount of wooden parts was considerably reduced to the simplest inside panels to which the upholstering was fastened. Composite and Weyman bodies were made, at the same time, of wooden frameworks covered with the artificial leather, furthermore the system DKW, where the wooden framework was covered with formed plywood and then with artificial leather.

By eliminating completely the wood, all-metal bodies came into being and this meant the third development stage. All-metal bodies had the framework firstly from metal profiles and metal sheet outside panels /Patent Arquin/. These profiles were gradually replaced by metal sheet inside panels and, finally, the present stage of shell structure has been achieved.

Along with the all-metal body tests, light metal castings /Viscaya, Gregoire/ and alluminium alloy panels were tested for its carrying elements /DYNA, Panhard/.

The efforts in reducing the car weight brought the designers of small and later even of medium cars to the idea of removing the frame and chassis units are mounted on a modified all-metal chassis-less body. By this the body has reached the fourth development stage.

The introduction of plastics, which are being used for bodies, not only for the inner outfit but also for panels and later even for frameworks, starts another period of its development stage. One of this trend is characterised by chassis-less

body from steel sheets and plastic outside panels, giving rise to a modern composite body /Trabant/, the second trend, by chassis body made exclusively from plastics with metal stiffeners. The third trend will proceed to chassis-less body from plastics /ABS-Bayer - BMW/.

The Number of Produced Types and Series

Bodies are made in different quantities and the number of pieces corresponding to different series, is quoted in this table. They are made once for all series or repeatidly in different time intervals continually.

Table II

Production	Number of bodies per day	Number of bodies per year	Plant capacity
1. piece	< 10	> 3500	small plant
2. small lot production	100	> 25000	
3. serial production	< 300	> 75000	medium plant
4. large-serial prod.	< 1500	> 375000	concern
5. mass production	< 1500		eventually several plants

According to the serial production, it is necessary to choose the level and stage of technology, as well as the number of complicated tools, jigs and machines. The serial production together with technology specify the proportion of costs for the equipment of production for one body. These factors can be maintained only, in case of a perfect evaluation of the type life time and its modifications. The highest serial production can be reached, if only one type of body is made and this varies according to the proportion of basic type, its modifications and

correspondence in parts.

The highest serial production is in case of grids, front mudguards and bonnet, and is, of course, lower with other units. The particular modification ratio is approximately as follows :

four-door body	50 %
two-door body	30 %
station waggon delivery van	10 %
coupé	10 %

On the other hand, it is necessary to choose such a serial production which takes into account the optimum flow of production lines and equipment in order to make maximum use of it. There must be also a certain reserve in case of sale fluctuations.

Pressing Shop

It meets the parameters of heavy body presses, the optimum flow of which reaches 1,3 mil. of strokes in two shifts and 75 % utilization per year. For large-serial production, only co-lines for several parts can be taken into account.

Welding Shop

The high timing of welding machines is reduced by feeding and removing of units. The smaller is the proportion of manual work, the higher is the flow and timing. On the average, the mechanized lines for smaller units reach an output of 200 pieces per hour, the larger units and the whole frameworks average 50-60 pieces per hour.

Paint Shop

The installation flow is given by the technological facilities of applying outside surface coatings which can be mechanized and for the inside surface, it is necessary to use hand

operated sporting [illegible] for instance, [illegible] for driving, the overlap speed is [illegible]

Another [illegible] the objective is [illegible], but the stamping [illegible] which [illegible] millions [illegible] practical [illegible] the average [illegible]

Upholstery [illegible] the [illegible]

[illegible] the use of [illegible] economical [illegible] the shortest time period [illegible] shows that the most economical size of body shops is [illegible] with 16000 [illegible] per year, when working in two shifts. [illegible] can be made with sufficient accuracy. It is necessary to ensure a certain reserve of about 20 - 30 % with each type for changes in production and sale fluctuations so that the capacity of this economical body shop averages 350 000 bodies per year.

Type Modifications

No producer can prevent from modifications. After a certain time, he has to face a difficult task, i.e., to adopt requisite modifications [illegible] production, especially in [illegible] series, for example 500 bodies of one type with [illegible] per day. Much more complicated situation comes up, in case of a complete change of body type. Some European makers solve the problem by shutting down the plants for all [illegible] time. Modifications may be partly solved by suitable life time [illegible] mainly pressing and welding ones, so that their life time should last until the substantial modifications are expected. This, of course, can be applied even for a new type. In this case, production for one type only, though favourable with respect to the serial production, appears to be inconvenient. Most of the

car factories make therefore two or more types at the same time and during the change-over; it increases the production type existing. For this reason, the installation capacity for particular types is chosen higher, so that, in case of one type modification may be possible to make a larger number of another type and to keep production going without reducing the number of labour.

Some big car factories have for each type a special body shop and the type modification does not interfere with the whole plant because the other body shops can increase their production, but the body shop in question must stop its production.

The type modification does not affect all the body shops in the same manner :

1. In the pressing shop, only tools will be replaced, perhaps several presses will be removed or supplied.
2. In the welding shop, the whole equipment must be replaced only, if it is not to use grids.
3. In the paint shop, if the new body differs only slightly in the size and, if the new completely different technology is not applied, no changes take place.
4. In upholstery shop, the jigs for high-frequency welding are replaced, body assembly line remains unchanged.
5. In assembly shop and department nothing is changed if a bigger car is not considered.
6. In galvanizing shop, the automatic griding machines must be replaced, metal-plating units may be used without changes, if the shape and size of new parts correspond to their parameters.

Sale Facilities

[illegible] depends [illegible] on the nature of [illegible] and on the [illegible] of [illegible] used in foreign [illegible] may [illegible] the [illegible] in [illegible] ly assembled [illegible] and [illegible] The [illegible] as shown by [illegible]:

1. As complete cars
2. [illegible] and [illegible]
3. Complete bodies for [illegible]
4. Complete [illegible], without upholstering
5. [illegible] complete body without certain parts as head-lights, bumpers etc.

The degree of partial assembly depends on economic arrangements and customs duties of the country in question. It is also the transport affecting this partial assembly, first of all, for better space utilization of means of transport. In the [illegible] case, better storage facilities [illegible] different partial assembly. Another factor in determining these parts in a [illegible] general, which is the factor of transport cost of a car as a whole, being [illegible] than in components and units [illegible], and therefore certain big car [illegible] their [illegible] cated assembly shops even in their own [illegible].

Life Time

Sale facilities determine to great extent the constancy of a type and also its total body life time. It is not only the question of strength [illegible] and weathering conditions, but also the time during which the body can be [illegible] to the sale, and during which its conception design is [illegible] outdated.

The average life time, pointed out as a normal one, is 5 - 8 years, in case, of an European body. It is worth while noticing that a longer life time can be achieved, for instance, Volkswagen has been made for 33 years, Renault 4 CV was made 10 years and Citroen 11 CV 20 years.

Apart from the increased life time of certain cars affected chiefly by the body standard, it is also the physical life time of the installation and tools, especially pressing ones, playing an important role. If the tool life time is shorter than the expected life time of the type, it is necessary to consider carefully, if it is worth while applying :

1. to make a second tool, which is not done any more in the mass production,
2. to carry out larger modifications with the existing type and make new tools for it,
3. to suspend the old type production by introducing a completely new one and all new tools.

These needs go hand in hand with the modifications required by sale.

Method of Technology

The body design determines, as the first condition, the intricacy and the number of particular components and its composition in sets and units, but it is also chiefly the technology which determines its metal sheet components. If the body consists of a large number of small-size pressings, the pressing process is simplified but, on the contrary, it increases the work and the total metal sheet consumption. Not to this, a greater number of pressings require longer welds, very often on not easily accessible and visible spots. This, of course, affects further more the surface treatment. Large pressings, which are not too many, are always more complicated and difficult to be pressed. On the other hand, accurate door, window

and cover holes are made in large presses. For this reason it is required that all parts and units should be designed with respect to the best technology, that is, for each of the most suitable materials, the smallest amount and variety of which is used. But it is necessary to set the best functional technical parameters, design the safe life time for each part and the whole body. At the same time, it must correspond to the conditions of serial production. In case of serial production of a new production, this must be changed as rapid and economically as possible reproduction. Several technological systems, which affect one another, take part in body making. What is a good technological method in one case need not be the same in the other. Technological methods are considered as a set to be and the most convenient combination should be found between the particular branches.

Technology and its level

Body materials have their own methods of treatment or technology, for which machines, tools, installation, space and proper incorporation into the production process are needed. These factors determine the technological process of body parts.

In the table, there is a technological profile of a body shop for :

A - all-metal body from steel sheets

B - body framework from steel sheets and outside plastic frames

C - body framework from steel girders and outside panels from light metal alloy sheets.

The table represents a required number of main technological branches.

Table III

Materials for body shop technology

Technology for	A	B	C
1. wood	-	-	-
2. steel sheet	/	/	-
3. steel girders	-	-	/
4. light metal sheets	-	-	/
5. light metal girder	-	-	-
6. light metal castings	-	-	-
7. glass-reinforced plastics	-	/	-
8. duroplactics	-	-	-
9. plastics AFC	-	-	-
10. surface finish of wood	-	-	-
11. surface treatment of sheets and girders	/	/	/
12. surface finish of plastics	-	/	-
13. upholstery	/	/	/
14. assembly	/	/	/
The total number of technological methods	4	6	5

At the same time, each material has its kinds and forms : metal sheets are supplied in sheets, coils and strips, girders in rods, textile in rolls, cotton in battings or bands etc. Technology must also take all these conditions into account.

Each technology has its modifications for differently mature and developed production and is economical only for a certain number of series.

The main methods in body making are :

1. actual material processing : profiling /sheet pressing/, girder bending, textile shearing.

2. assembling [illegible] units and units into units [illegible] of metal sheet [illegible] and girders, riveting, welding, stitching and [illegible] frequency welding of textile, [illegible]
3. chemical treatment [illegible] degreasing, forming phosphating, surface sealing of coating compounds, also [illegible] of ornamental parts.
4. body assembly [illegible], upholstery fitting, electric equipment and finish.
5. body tightness and noiseless-run tests
6. car assembly and final body outfit.

In the choice of technological modification, that is, the degree of technology, it is necessary to consider which should be employed so that the body making might be really economical.

The following modifications of technological [illegible] used for the series and large series production.

1. metal sheet processing by forming
- pressing on [illegible] or fully mechanized lines with great number of tools
2. joining metal sheet parts :
- welding in large, by means of highly efficient welders and multiple spot welding machines,
- welding on lines with manual or mechanical welding and with interoperational handling
- joining by folding and partial cementing
3. surface [illegible] by coating compounds
- manual or mechanical gun spraying on lines connected to the central distribution of spraying compositions
- dipping or electrophoresis
- spraying in electrostatic field

4. metal plating surface treatment

- mechanized grinding, by means of automatic grinding machines
- metal plating in automatic machines

5. upholstery :

- textile cutting in automatic line process
- high frequency welding in partially or fully mechanised lines
- stitching by multi-needle machines
- joining by means of clips, cementing

6. body assembly :

- mechanical screwdrivers and runners
- chiefly manual assembly of already made units
- cementing

Labouriousness

Labouriousness results in design complexity, material used and the number of series. As for production cost, the body is not a decisive factor, it is 3 - 5 %. Much greater influence has the material, its proportion on production cost makes 60 %.

Labouriousness shows the necessary number of workers depending, of course, on the range of cooperation.

By enlarging the cooporation, it is possible to increase the output volume in the parent plant.

The labouriousness ratio of a chassis-less body and chassis one makes about 2 : 1 in which the body includes the whole assembly, its testing and sending off.

The labouriousness ratio of a chassis body to a chassis makes about 1.4 : 1.

On the average, the particular technological methods of a

(D/Pg.) to
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passenger [illegible]. Body structural [illegible] material
[illegible], as follows :

metal sheet [illegible] [illegible] %

joining [illegible] %

surface finish by painting [illegible] %

surface finish by metal plating [illegible] %

insulation [illegible] body [illegible] [illegible] %

body assembly with [illegible] and its
units, outfit, taste and sending off [illegible] %

other methods [illegible] %

The labour expenses of a chassis-less body, for a small car, is
30 - 50 hours in a large series production.

Its structure complexity and the degree of the inside equipment play here an important role.

The effect of various modifications, framework materials, size and body outfit connected to the labour-time can be expressed by the following indices :

Design	1. chassis body	10 %
	2. chassis-less body	40 %
Modifications	1. four-door closed body	20 %
	2. two-door closed body	10 %
	3. sport body	10 %
	4. station wagon	80 %
Framework material	1. steel	80 %
	2. light metals	90 %
	3. plastics	40 %
Size	1. small	80 %
	2. medium	90 %
	3. big	100 %

Outfit	A. Standard	80 %
	B. De luxe	20 %

The mentioned ratios do not take the number of series into account and are purely a technical index of complexity and resulting costs on the metal production. The indices of this series number for steel and light metal chassis are :

piece production	100
small series production	400
series production	200
large series production	80
mass production	40

These indices are different for the plastic bodies because they are manufactured as components and completed units

for piece production	100
for small series production	170
for large series production	350

Production Organisation

A body is an important part of a car and for this reason, its production and producting organisation must be on the same level as, in case of a chassis. The production is separated units corresponds to the modern design of production organisation : productional branch has machinery for all operations, required for the complete parts making, set of units or, to a certain extent, of body work, i.e. surface finish. Machines and installation are arranged in such a way so that the material and production flow should be the shortest and handling limited to the smallest extent. For the body making differs substantially from the chassis components production.

While in the case of chassis components production, nearly the same technological methods are being used as, for instance,

drilling, turning, [illegible] and others, the production [illegible] body about [illegible] and is completely [illegible] the one of [illegible] and upholstering. [illegible] major [illegible] body which [illegible] the [illegible] upholstering [illegible] final assembly.

[illegible] effect [illegible] the [illegible] migration. This [illegible] different, according [illegible] dustrial [illegible] and [illegible] in plant. [illegible] series (Austin, [illegible], [illegible], [illegible], Renault) it [illegible] several [illegible] and made by [illegible] finished bodies. [illegible] is also an important factor in the production organization. It is chiefly used for the [illegible] and product handling because in the series production, the [illegible] stick to the [illegible] set forward by Ford in his production in 1913. [illegible] should be brought [illegible] the [illegible] and not vice versa. [illegible] in many [illegible], as [illegible] of the [illegible] process, for instance, when the [illegible] through the [illegible] in the paint shop bath.

Depending on the material from which the body framework is made, and if the framework and panels are [illegible] together or separately, further variants come into being, when leaving aside the [illegible] flow of material and [illegible].

These large series production flows are being used in the world :

1. Normal, [illegible] for the most body makers : framework with already mounted panels
2. the framework [illegible] carried out separately from the [illegible] even when they are from the same material ([illegible] and [illegible] and [illegible]).

3. steel sheet framework and plastic panels pass first separately and then the panels are mounted on the framework and further operations are made together /Trabant/,
4. the front part, i.e. front mudguards, bonnet and the front are made separately from the actual body till the final assembly. This method is chiefly applied in the USA.

It is the body building which determines the final car assembly methods ; whether it has a chassis-less body or a chassis.

Production

At present the all-metal steel body is widely used and the production methods as well as machinery, for its large series production, are at the top level.

Pressing

The sheet pressings are the basic framework parts, asking for accuracy, perfect surface quality and economical production. Small and medium cc. bodies have 300 - 400 metal parts. Nearly 80 - 150 metal parts are pressed for the chassis in the body pressing shop.

An important pre-requisite for good pressings is the high quality cold-rolled and deep-drawn sheet, produced in oxygen converters by modern metallurgical processes from the best raw materials. It must prove sufficient strength / / / to withstand large deformation and to be workable enough / / to make these deformation possible. The chief chemical properties of sheet from killed and rimmed steel are :

yield point = 17 - 30 kp/mm²

yield point to strength limit ratio = 0,60 to 0,68

It is being supplied in metal sheets, coils and special dimensions. The coil to sheets ratio is / 3-4 / 1 / ? 8/ in European pressing shops. The coil weight goes upto 15 tons, with

the width [illegible]

All [illegible] technological operations are used for the pressing production. In principle, the operation flow is the following one :

Operation made in advance :

cutting, that is the cutting of developed shape,

renovating, chiefly for the outside panels, by means of which we can prevent wrinkle formation,

lubricating, either during renovation or by special additional lubrication before the pressing operation ; simple operation without lubrication.

Basic shape production :

drawing : large thin metal sheet pressings are being drawn regularly in one operation;

airing with small radius pressings with sharply marked pressing tools.

The excessive material removal :

burring

Final operation :

edges and flange bending,

hole piercing of different shapes,

overlapping

Leaving aside the classical pressing methods, rolling and pulling over on special machines is being used for the production of bumpers /Redman and Co./.

Pressing tools

For small components, there are chiefly the classical tools, i.e. with standardized stands as far as possible with the same height for the particular press category enabling its preparation and work. Pressing tools for medium and large pressings made by the vertical presses from 315 Mp thickness upwards [illegible] single operation only. They have,

rai, its own mechanism for the pressing removal, centering stop, its own waste conveyors from tool center to the side, cutting tool for waste, chutes for waste and especially arranged grip for pressing removal. These tools are made of Ni, Cr or Mo alloyed grey cast iron. Its minimum life time is about 0,5 mil. pieces so that is not necessary to produce duplicates being costly and not always the same with the original tool.

The outfit, i.e. the number of tools for one component, is for large series production 3 upto 4,5 on the average. Tools are very costly especially for large pressings and represent a considerable amount in production establishing.

Machines

In the pressing shop, metal sheets are being processed by table shears, by eccentric and double stand presses. The most widely used machines are the presses with an impact force from 315 Mp upto 1.500 Mp, the table size goes upto 4.000 x 2.500 mm. The proportion of presses with single ramming action to double ramming ones is

/ 5 upto 8 / : 1

At present, chiefly power presses are being used in body pressing shops. Presses with double ramming action have double speed, changeable during stroke so as not to exceed the sheet forming speed. /18/min /.

The number of strokes made use of, depends on the type and press size and is 8 to 20 per minute. In case of two shifts, its output is about 1,4 to 3,4 millions of strokes per year when utilized to 75 %. This efficient flow in the series production is enabled by mechanical devices : clip feeders, strippers, turnover devices and pressing feeders interoperation conveyors.

Heavy tool exchange /upto 50 tons/ can be simplied and short-

ened by a special feeding device /a movable cart or a transportable platform/ and withdrawing press tables with mechanically chucked tools. Another accessory to ordinary presses are the single-operation presses for smaller components, i.e. for nuts, caps, pivoted arms etc.

Material and pressings have to pass the pressing shop in the following sequence: The material from the rolling mill is stored after having passed the input inspection. From here, it is handled either directly to the pressing shop or to the cutting shop and then to the pressing shop. Finished pressings are being checked and stored in intermediate stores from where they are sent to the welding shop.

Metal sheets are being cut by means of table shears, coils in dividing or shearing lines. These dividing lines shear the coils to sizes, but the shearing lines make directly the correct shape of the cuts. The capacity of these shearing lines consisting of a decoiler, straightening machine, controlling loop, feeder and press, depends on the cutting length and performs up to 60 strokes per minute

Huge body presses are grouped in pressing lines by which one can press even several different parts for large series production. These are the so-called pressing lines with an output of 2500 to 20.000 pieces. These lines consist of 3 to 8 presses based mostly by a press with double ramming action. These lines are partially or fully mechanized with an output of large pressings from 350 to 500 pieces per hour /roofs, sides, floors/, with medium size pressings 450 to 700 pieces per hour. At present, there are already in existence lines, consisting of presses with single ramming action with an output reaching 980 pieces per hour

Heavy presses are being built for grates over the empty space

or channels. This empty space contains waste conveyors falling into them by means of chutes from presses. The waste is squeezed into fagots weighing upto 180 to 200 kg. Presses are continually or intermitently operated.

Pressing tools are put aside behind the pressing lines or in a special room. There is always a maintenance man in the pressing shop.

Handling is taken care of by cranes /pressing tools, maintenance and press repairs /carts/ material, pressings, tools/ and conveyors/waste and pressings/.

The pressings are being checked and stocked at the end of pressing lines and finally stocked in intermediate stores /sometimes even in five layers/. In some plants, pressings are handled by means of overhead chain conveyors, hung freely or in pallets. This conveyor may serve also as an intermediate store. /Fiat-Mirafiore, Volkswagen-Wolfsburg/. From now on, there is a tendency of storing pressings in pallets in special intermediate stores provided with stacking cranes /Pressed steel/.

Pressing shop layout.

Modern pressing shops have a along side bay to which there are erected short transversal ones. In the alongside by a there is a store and sheet cutting shop, i.e. the store and tool maintenance. In the transversal bays, there are presses and pressing lines. The intermediate store of pressings is in one of the next alongside bay.

Body assembly

A body is gradually assembled from particular pressings in a welding shop and hammer shop. It is the layout of the welding shop which considerably effects the body welding. A chassis-less all-metal body consists of the framework itself and the grate

consisting of further units : floor, seat bottoms, cross wall partition, sides, forming the door frames with precise holes for them, or with the rear wheel covers, roofs with front and rear window frames, cross walls with platforms under the windows and front wheel ready for mounting the welding set. Removable covers parts are mounted on the framework : front and rear mudguards, fronts and parts which are supposed to be opened /doors and bonnets/.

The method of technology follows the pressing material /steel, light metals/ and requirements for joints. The following methods are being used :

1. /Screwing / bolting/ for removable parts.
2. /Folding for outside and inside door and bonnet panels /permanent joints/
3. /Welding for units, sub/units and the whole framework /permanent and tight joints/
4. /Soldering / brazing/ for levelling small body surface, unevenness in the course of body finish /soldering/. Some of these joints are being brazed.
5. /Cementing for fastening intermediate stiffeners to the outside flat panels without marking on the outside surface /hardly removable joints/.
6. /Rivetting for joining light metal alloy panels /hardly removable joints/.

The proportion of welding to other joining methods is, measured in length 3,5 : 1.

Locating jigs

Metal components are assembled in jigs. It is a steel structure with contact surfaces, adjusted according to component shape with stops and clamps, without damaging its outer surface and

enabling an easy access to all joints. These jigs are fixed, or rotating, stationary or movable, jutting out and suspending. They are used in folding, welding and rivetting.

Machines and installation

Each technology requires special machines and installation. While for screwing and bolting, the ordinary spanners and high-frequency electric or pneumatic screwdrivers are sufficient, for bfolding machines or tools in presses. Soldering or brazing is performed by gas burners in properly exhausted boothe. For cementing being applied, at present, for joining metal parts, special machines are being designed with accurate cement dosing by jets to properly cleaned spots. For riveting in jigs, special riveters and riveting machines are being used for large strait units.

Welding is used to great extent and welding machines are at high stage of development and output. For spot welding, stationary welding machines with an output of 160 kVA are used and portable spot welders /tongs/ with suspended transformers with an output of 80) kVA. Large series production makes possible to use economically different types of multispot welders, with a lifting or movable table and interchangeable head and jigs, or table tape. Number of spots is 200 with an interval of 30 sec. unto 3 minutes. Tight welds are welded by means of seam welders. These are stationary with an automatic guide of welded parts to wheel electrodes or suspended with manual guide. Smaller parts, chiefly from thicker sheets, are welded on presses of an input of 250 kVA. Profiled parts, as for instance, the front window pillars and door window frames are butt welded with flashing.

All resistance welders have an automatic control of welding cycle and hard operating regime /short time 5 to 15 periods and

high current from 8 to 35.000 A/. This enables very high welding speed without smaller deformation by heat.

Machines for arc welding are rotating types with an auxiliary device for argon-arc welding /CO_2 or argon/.

Production layout

Smaller sub-units are welded in groups, larger units and the whole framework continually. According to this system, pressings are taken from the intermediate store : smaller parts in pallets, larger ones continually in pallets on carts or by means of an overhead conveyor.

In case of a large series production, larger units and the whole framework are welded in lines, the composition of which, equipment and speed depend on the technology size and shape of pressings and complicacy of the welded unit. These lines have stationary or mobile jigs.

Welding line capacity depends, first of all, on the auxiliary operation time. The line capacity, in case of mobile jigs or mixed lines for larger units, averages from 30 to 350 pieces per hour, for framework assembly and sheathed bodies from 30 to 70 pieces per hour.

Characteristical features of welding lines for main units is a type of jig, line arrangement and feeding system of pressings and welded units. Lines are manual, partially or fully mechanized. Sometimes they are combined with more characterical features.

A line can be a single or multiple one, circular as a table or conveyor, oval as an irregular closed circuit. These can be two parallel branches connected at ends, by means of cross shifters. One is an operating branch and the second reversible or both operating ones. Finally, it can be a direct branch with some further auxiliary vertical direct branches or in U or L shape.

The systems of line feeding are : hand feeding in fixed jigs,

rods with reversible movement grippers, reversible rods with a lifting device, mobile jigs on rails /timed or continual feed/, rotating or tilting devices with an easy access multi-spot welding tables, sliding vertically for direct feeding. A set of main units : a grate consists of floors, cross and longitudinal beams, wheel covers, cross partitions, seat etc.

Grate is assembled	Used by firms
1. from several previously assembled sub-units without running longitudinal beams	Lincoln, Fiat 1800, R 16, Vauxhall Viva
2. From particular parts, without longitudinal beams	S 1000 MB, GM Corp. /Auctin/
3. As in case 2, but with longitudinal beams over the whole length	Simca, Peugeot 404, R 8 - R 10
4. The body is without the front part and has a short grate only	Ford Buffalo
5. Instead of a grate, there is platform type frame with floor	R 4 CV, Citroen Ami 6

Lines are equipped with tongs and multiple spot welders.

Sides consist of :

1. particular smaller pressings,
2. one frame pressing and further smaller components in the following modifications :

Side parts	Used by firms
1. particular pressings	R 4, Ami 6
2. one piece frame without the central pillar	Simca 1000, S 1000 MB
3. one piece frame with the center pillar	Renault Dauphine, R 16

Side parts	Used by firms
4. frame with rear mudguard panel	Vauxhall

Also tongs and multiple spot welders are applied in these lines. Roof consists of main pressings /roof panel/ and further smaller ones /door and winder stiffeners, window frames, front and rear platforms/. In case of roofs, usually one multiple spot welding machine is used and an auxiliary working place for sub-units welding in beforehand. Here also, there is wide application of flashing welders for window palaces /Ford Halewood/. Doors and covers are generally assembled from outside and inside panels. Top parts with windows are either from one piece with bottom metal parts, or profiled frames.

They are assembled :

by folding the outside panel edges over the flange of the inside one,

by cementing, only in case of the cover /not used very much/ - newly applied technology.

These lines are mostly direct with tongs, multiple spot welders and special folding machines, rarely circular or oval.

Frameworks are assembled following its parts. In principle, three basic methods are applied :

1. Sides are fastened to the grate, then roof, windows frames with platforms are welded /methods widely used/.
2. A body is assembled from the front and rear part, center floor and roof.
3. First, the top part is made, i.e. sides with roof and window frames and the whole is mounted on the grate.

Lines consist of :

1. Stationary jigs, mobile, for the start of grate, then the roof and window platforms /Lincoln, Ford Genk, Š 1000 MP/.

2. Mobile jigs, as in the point 1.

3. Combined mobile jigs, with a slide for grate to which the suspended mobile jigs with welded body side are connected. /Simca, Vauxhall/.

Partially welded frameworks leave the lines. Welds are finished on further lines, being either separate or connected to lines for sheathed body. Finished frameworks pass to lines /plate conveyors/, the so-called sheathed body. In these lines, the body surface levelling is carried out by soldering or by plastics, doors and covers, covers and mudguards are mounted after final finish, by means of which some small surface scratches and defects are removed and the body is ready for surface finish. Welding shop layout is always subjected to body building and reducing unnecessary handling time. Handling is both by carts with pallets and by overhead conveyors, having an advantage of not taking much floor space and can be handled in shortest way.

Surface Finish

The first task for body surface finish is to assure its weathering resistance /corrosion/ and enhance its esthetical appearance. Prevailing part of body components is made of steel sheets, completed by economically paying amount of corrosion resistance materials, as glavanized sheet anti-corrosive sheet or light metal alloyed sheet.

Smooth surface, simple shape, advantageously ended panels facilitate not only the surface finish, but also car maintenance. For surface finish, chiefly coating compositions are being used, the advantage of which is high lustre and resilience. They require dustless atmosphere and higher temperatures for drying.

Coating compounds	Drying temperature /°C/
alkyd melanin	100 upto 140
acrylate	100 upto 140
epoxyde	150 upto 180
soluble in water	200 upto 220

Copper, nickle and chromium metal coatings are used for ornamental metal coating of bumpers, bars and hub caps.

3.3.1 Surface finish by coating compounds.

The number of coating layers applied after phosphatizing shows us the degree of surface finish. In large series production of small and medium size bodies, it consists mostly of 3 degrees treatment.

Table IV,

The technological sequence is presented in the following table :

Operation		Thickness in /0.001 mm/	Degree	
1.	Degreasing	-	-	-
2.	Phosphatizing	3 to 5	-	-
3.	Priming			
	- wetting	30	according to the choice	
	- wetting with electrophoresis	30		
	- cold spraying	30 to 50	according to the choice	
	- hot spraying	50 to 70		
4.	Interlayer /filler/	50 to 70	-	
5.	Top colour enamel	40 to 60		
	Total after grinding	100 to 160	3	4

All spots on the body do not have the same degree of surface finish.

Suspended bodies are degreased and phosphatized by spraying and then dipped into the coating compound by dipping. It is possible to achieve better protection of hollow parts, i.e. the entire body and its hollow profiles, during electrophoresis, coat particles and water soluble coatings are deposited by current in equal layers on all body spots, but for filling the cavities, it is necessary to use an auxiliary electrode. The dipping process takes about two or three minutes and coatings are drying at temperature of 160 °C upto 180 °C.

Primers, fillers and top coating enamels are applied by pressure spray guns /hand or automatic/ electrostatically or by coating. This coating is carried out in special air-conditioned spraying tunnels, heated to 32 °C and with relative humidity of 65 %. The air circulation is 10 upto 12 times per minute. The body in the tunnel is either suspended /for spraying primers or fillers/ or in a slide /for top coats/. Coating compound efficiency for normal spraying is about 60 %, for electrostatic one nearly 90 %. But operating safety of spraying guns and the possibility of changing shades is much higher. During the body coating finish, the particular coat layers are dried. During the drying process, not only the simple thinner evaporation of the coating compound or water takes place, but also, at the same time, the coloidal and oxydizing processes during which the layer hardening is completed. Drying is by convection, i.e. by share, or by radiation, i.e. by emission. Convection driers are heated by hot air, hot gas in the heat exchanger. Radiation driers are equipped with infra-red bulbs or with dark radiators /ceramic heaters/. These are mostly tunnel driers and are very often located on the floor above the spraying tunnels or paint shop.

Paint shops for bodies are extremely complicated devices. They consist of spraying booths, dipping tanks and ovens. For reliable and economic operation, they are provided with further equipment : smoothly operating body handling and other parts for technological processes ; air-conditioning devices for spraying booths and paint shop, water conditioning for demineralization, draining of rinsing water from the spraying booths. Special agent is added to water, which enables that the coating spray flows on the surface in the tank where it is taken off, preparation and distribution of coating compounds, production control devices.

Handling is an integral part of production process, especially in case of bodies passing through the tunnel driers. Furthermore some small cars, runners, measurements, roller beds and floor and overhead conveyors are being used.

Air is an important medium, affecting directly the coating quality and worker's health and output. It must have, therefore, constant temperature, humidity and purity. The air for spraying booths is conditioned in special stations.

During the surface finish, there is a great water consumption for body rinsing, for grinding primers and for rinsing in spraying booths. Demineralized water, being treated in ion exchangers, is used for the last rinsing.

Coating compounds, for safety reasons, are stored in a next-by building. Next to the store, there is generally a central preparation room, assuring constant coating compound viscosity, its everlasting shade, sufficient supply for continuous spraying of different shades and different sequences.

Production control and conveyor speed run, booths and driers operations are manipulated from the central control desk provided

with synoptic chart with signaling lights and dispatching.

Spray shops

Spray shops have generally two main parts : the first part for final priming and bodies are put on overhead conveyors. In the second part, bodies are completed and sometimes put on trucks. Line capacity is conditioned by the coating compounds. Line regime in present spray shops is two minutes, so that for 500 pieces within two shifts one line is sufficient. For larger series production the lines are multiplied : Simca has two, Renault - Fline has two for priming and three for top coating enamel and Volkswagen seven lines. New Vauxhall spray shops in Elesmere-Port plant is designed for 35 bodies per hour. After completing booths and driers, which has been already taken into account, its output will increase to 50 bodies per hour. Body inspection is done very carefully and special line is sometimes installed for repairs. In the Ford plant, enterprise Gent /Belgium/, every day one body is exposed to the effect of superheated steam for a time of 20 hours in order to find out the adhesion coat aging. Every month one body is tested in the salt atmosphere for corrosion resistance. It is dismounted after the test and the effect of salt vapours on particular parts is examined.

Metal coating

Bumpers, hub caps, strips and other ornamental parts made of steel sheets are protected against corrosion by means of copper nickle and chromium plating. The decisive factor is, here, not only the combination of mentioned metals and coating layer, but also its porosity. The following combinations were established as suitable for prevailing part of climatic conditions :

Table V

	Cooper / m/	Nickel / m/	Chromium / m/	Total / m/
polished 1	cyanido 8 - 4	double 25 - 30	without cracks 0,8	47,3 - 30,
	cont acid 20 - 25		double 1,2 - 1,5	
3	-	double or triple 35 - 40	microcracks 0,8 or microporous 0,5	35,0 - 40,
not polished 3	primer and layer 15 - 20	balancing 1st layer 5 - 8	without cracks 0,8	
		polished and double 25 - 30	or double 1,2 - 1,5	45,8 - 59,5

Metal coating technology consists of : pressing, surface grinding, if it is not pressed from glossed metal sheet ; actual metal coating /bright or semi-bright/ eventual final polishing.

In the large-series production, hand work is limited to the smallest extent and hand grinding is replaced by automatic machines being designed even for highly complicated components which, of course, must have a required technological method.

Degreasing, rinsing and metal plating baths form the part of automatic machines enabling an automatic pass of parts from tank to tank and its motion in the bath following the predetermined time schedule.

Automatic metal plating machines are being designed for an output of 3.000 m2 of coated surface within 8 hours. They use filtration and pumping over solution. The current is supplied by rectifiers.

Elastisity and flow production in workshops is ensured by sufficient stock of painted bodies between the paint shop and upholstery shop. This stock is taken care of in advance and controlled from the dispatching centre. Bodies coming from the paint shop are automatically sorted into storage lines and again, without a hand touch, sent to further workshops /Austin Standard, Volvo/. This stock is for half a day or for one day, i.e 300 upto 500 bodies.

Upholstering

The conted bodies are sent from the paint shop to the body assembly shop with such an equipment so that they should fulfil its main task : to offer the passengers a safety drive, comfortable steering and to reduce fatigue during long trips. The body is upholstered, glazed, provided with seats, different instruments and mechanism. Seats, upholstering of inside walls, roof and floors are made in upholstery shop, from where they are transported to particular places of assembly lines.

Material :

It is a coating and filling material /textile, cotton wool/ cardboard, rubber, glass, plastics, auxiliary and joining material, fittings, electric equipment, ornamental and functional accessories, Some materials are further processed, others are brought as completed parts and are assembled into units and sub-units. Textile and plastic materials are being supplied in rolls, cardboards in boards. The technology conforms to material and series number. The main operations are : textile and cardboard cutting, putting coats and seats together, mounting of coats, packings and electric accessories, glass, ornaments and tightness test.

Particular coating parts are cut from an ordinary or plas-

tic material, polyurethane and PVC foam decks. Two methods are used :

Roughly 80 layers of material are cut together on a long table, the top layer is chalked according to the former and the whole layer is cut by hand with electric shears or cut with band saws.

2. The coating parts are being cut with presses in mechanised lines.

Putting together of coatings depends also on the material used. An ordinary textile is being sewn, the plastic one is high frequency welded, some more complicated units and high frequency welded are sewn, as for instance, the whole seat coatings. Multi-needle sewing machines are used /even with 46 needles/, of robust design with a stitch not requiring bottom shuttle replacing.

High frequency welding is based on dielectric properties of plastic material : during the current flow of 20 upto 40 MHz, heat is generated in the joint, sufficient enough to join permanently both parts with a welding width of 3 mm under a constant pressure of shaped electrodes. The device for HF welding consists of a generator with an output of 65 kW, by means of which it is possible to weld an area of 180.000 mm3, furthermore of a press with an electrode and its mechanism/ shifting table, reversible table, rotating table and withdrawing table/.

Production of main units

Door filling. Plastic covers are Hf welded and ground cardboard is cut under a press. The cover is cemented on the wrong side, clioned or, at present, Hf welded in one operation with a special jig, by means of which the cover edge is folded over the cardboard.

Roof cover. Strips for fastening the roof by wire arcs are

stitched : now, they are made of plastic roof material directly by folding and Hf welding on special automatic machines. Seat cover. Particular parts, especially the centres, are Hf welded together with filling elastic material. The whole net, i.e. the whole cover is sewn.

Seat assembly. Here, it depends on the fastening of elastic filler /spring zig-zag, foam plastic material or rubber/ to the metal framework, and on the proper stretching and fastening of the inside cover. This work is split into partial operations so that the seat might be assembled on the line. The line consists of an apron conveyor onto which the seat is normally placed, or the seat frame is fixed into special stands, facilitating the correct position of the seat and the work. Stands are pulled by floor conveyors. Mostly clips are being used, in great extent, for assembling seats. Clamping tools are automatic.

Body assembl

Painted body is mounted on a truck of the floor conveyor on the assembly line. Then upholstery, glass, seats, electrical equipment, fittings and ornamental parts, are mounted, bumpers and chassis parts later on. Next to the main line, there is a preassembly working place for instrument panels, bumpers, or for the whole front part /USA, Citroen Ami 8/.

The applied technological methods are screwing, clipping, cementing and assembling by means of special fastening elements.

On the line, the work is going on outside, as well as inside the body. In general, several body types are assembled for the same type of cars and special outfit, according to the customers' wish. This "mix" is carefully controlled not to overload the line or not to make full use of it. In this

way, it is possible to achieve a more equal employment of people and the line is not delayed. Modern controlling devices are being employed for the "mix" control lately /computers/.

Assembly lines are supplied :

by pallets brought to the working place. This method is the most common and is sufficiently elastic,

straight supplying line :

by overhead conveyors.

Assembly, dispatch and forwarding

According to the design, it is the question of joining the chassis body with the chassis or the chassis-less body with the chassis parts. The car design and the body composition determines the sequence of assembly behind the upholstery shop. Bodies are sent to the assembly line in different stage of completion, following the organized production :

The completely painted and upholstered chassis body with floor or the chassis-less one.

The completely painted and partially upholstered body, i.e. without the floor being the part of the flat frame.

The completely painted and upholstered chassis or chassis--less body, but without the door, covers and mudguards, being painted and upholstered and coming to the assembly line separately from the actual body.

Both main parts of the body are brought to the assembly line on trucks, on hooks or stands of conveyors, being synchronized in such a way so that the both main parts are put on one another. A certain irregularity is balanced by regulation the speed of one conveyor from a special panel.

After joining the both main parts, further chassis compo-

nents as fuel tanks, pipelines, pedals, steering and wheels are being mounted on the line and then the car leaves the line. From now on, the final testing and inspection goes on, body tightness test, steering geometry, running in on cylinders brake tests and headlights adjustment. The testing is done on the line, and, where, it is necessary for the car to be at standstill, a special working place is established, next to the line and the car is mounted on it.

The assembly line layout follows the chosen technology. Some operations asks for difficult work over one's head. The work in lines is continual and individual operations are split into shorter sections in order to achieve the full utilization of the timing sequence on all working places, for instance, more people are sent to this working place or greater number of working places is installed for this operation on the line.

Different types are being mounted in different variants and in irregular sequence on the car assembly lines as in case of body assembly /mix/. Similarly as in case of body assembly, even here, the equal line utilization must be controlled by means of computors, as in case of "mix". The material supply of lines belings to an important organizational requirements of line production, especially in "mix" assembly.

The line working places are provided with material and components in pallets from the store, in pallets in original containers directly from manufacturer, direct supplying line being synchronized with conveyors of other assembly lines /chassis units/. Orders to the working places, where the necessary material is being prepared and which are at the start of lines or other strategic points of production, are sent by means of telex, pneumatic mail or by other means from the central dispatching

panel. This dispatching center must have a survey of stocks and its supplying. Finished cars are transported on their own axle, by special car lorries or by rail in special two--floor waggons. In case of long distance forwarding, cars are greased before loading.

Body Shops

The body production in the first body shops was exposed, from the very beginning, to an increasing pressure of controlled and mechanized series production. Out of this great number of body shops, only a few remained in the year 1925 after the Second World War. But also these were directly influenced by the car concerns. At the same time in this period, new body shops in these car factories came into being, and, at present, they are at a very high organizational and technical level. Some of them were taken over by famous body shops and, today, the firm Budd in the plant Ford, Fisher Body in GMC, Pressed Steel and Fisher and Ludlow in BMC and Karmann Chia in Volkswagen. At present, the independent producers, as Chausson, Pinifarina, Bertone, Ghia, Vignale, Ossi, Zagato and Michelotti, are also more or less dependent on larger or smaller car factories.

In present days, we can distinguish these types of body shops :

1. independent body shops, manufacturing prototypes and special bodies averaging from one body per month, and, in case of several sport designs, even 70 bodies per day. Pinifarina, Bertone, Ghia, Vignale, Ossi, Zagato and Michelotti fall also into this group.
2. independent body shops, manufacturing the modifications for large car factories averaging 300 bodies per day /Chausson/.

3. the car body shops manufacturing all types of bodies for their own make, for instance, Fiat, Simca at other body shops.
4. the car body shops, manufacturing only one body type for their own make. One of these representatives can be the Renault plant with its body shop in Billancourt, Flins and Sandouville.
5. the body shops, manufacturing welded framework units being assembled completely in the body shops of the type No. 6.
6. Assembly body shops

The body shops of type 1 and 2 get their basic body parts from the car body shop they are working for. These are mostly grids, front mudguards and bonnets. The body shops of type 4, 5 and 6 cooperate together to a certain extent. The number of series for particular types of body shops is mentioned in table No. 6.

Table VI

Type	1	2	3	4	5	6
Prototypes	|					
Piece production	|					
Small series production	|	|				
Medium series production		|	|	|	|	
Large series production			|	|	|	|
Mass series production			|	|	|	|
A body shop has :						
a pressing shop	small	|	|	|	|	
total production	|	|	|	|		
some other shops, for instance, a welding shop					|	|

Body Shop Layout

Body shops are design for the maximum expected output, built according to their "needs" and the buildings with technological equipment are gradually completed with increasing sale. Big car factories have a separate body shop for each type. These body shops are being mostly design for the whole technology : pressing shop, body shop, car assembly with dispatching and forwarding.

The halls are mostly on the ground floor, some of the body shops from the early days are one-floor buildings /Ford, Volkswagen/. Lately, some of these body shops are built again as one-floor buildings or they have some of their workshops on the first floor, for instance, upholstery and paint shop /Ford - Hallewood, Simca and others/. The handling between the floors is solved by means of floor or overhead conveyors. In case of newly built body shops, several basic layouts are being applied, with respect to the reduced handlin between the factory buildings and possibility of further extension :

1. Long production halls, connected by one traneversal hall for social facilities and offices /Renault - Flins/.
2. These production halls are spread around the two vertical branches /Citroen - Rennes/.
3. The two hall units : one consisting of a pressing and welding shop, the second of a paint and upholstery shop and assembly /Ford - Gent/.
4. The two hall units : the pressing shop as an independent unit and an upholstery shop, as the other /Fiat - Miraflore/.
5. As one unit /Ford - Halewood, Vauxhall - Luton/.

In encreasing the body production capacity, certain number of big car factories locates these body shops at considerable

distances from the parent plant. There are several reasons for it :

shortage of labour in this parent plant,

lack of space for extending the production in this particular plant,

natural and economic requirements, being interested in reinforcing industry in some other regions,

limitations in import and custom regulations, if this plant is abroad.

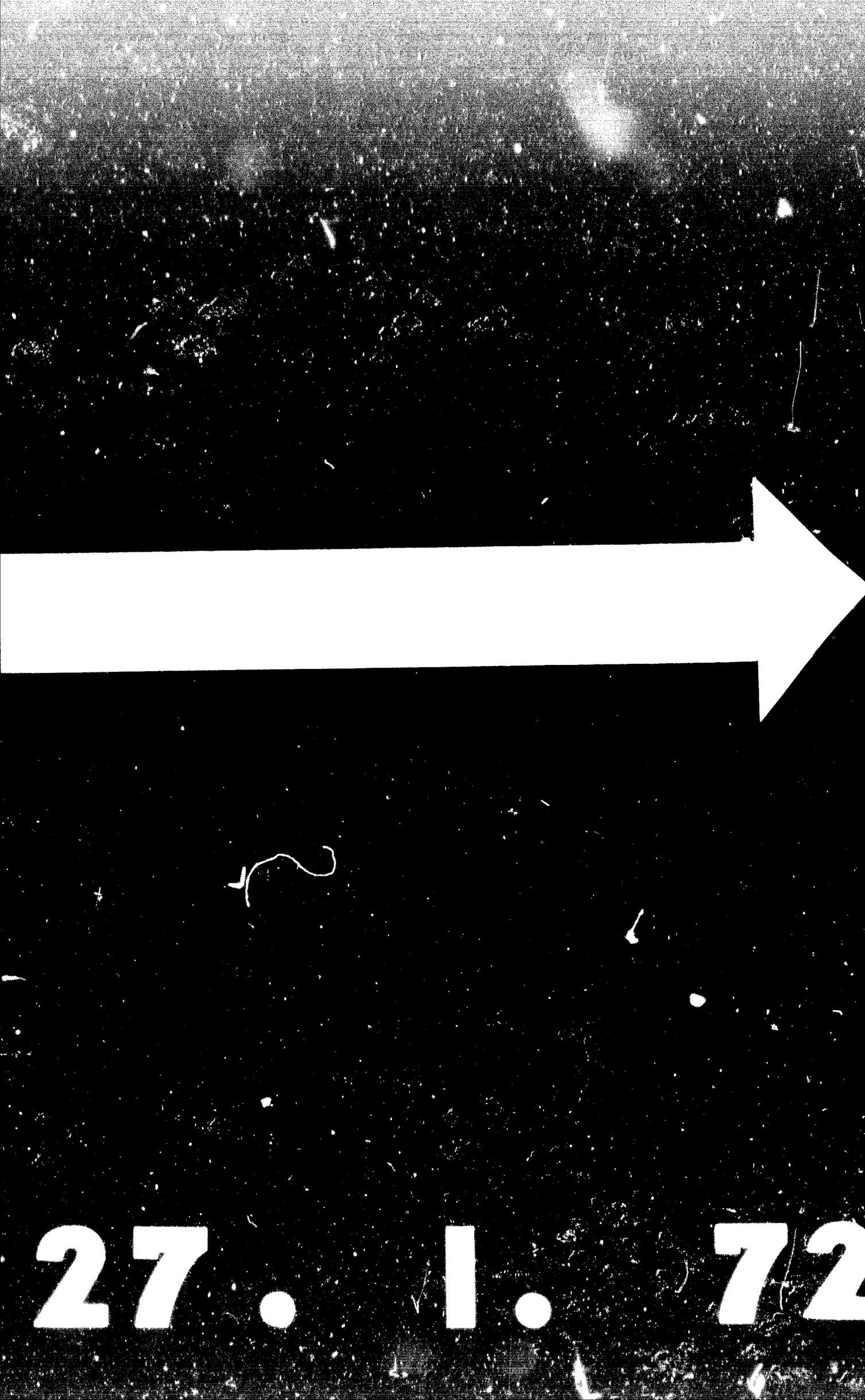
Transport economy and further cooperation must be examined in selecting the place. There is a tendency to erect a new body shop in the vicinity of the main means of transport /roads, railways and water transport/ and to make use of the same means of transport for the parent plant.

The relations between remoted body shops and assembly body halls of completed cars are very complicated, especially in big car factories.

The Renault plant has its parent plant in Paris - Billancourt, big branches in Flins, Cléon, Sandouville and Le Mans.

In Billancourt, the bodies for R 4 car are produced, and some pressings for R 16 car bodies, in Flins R 8 and R 10 bodies are produced and further pressings for R 16 ; apart from this, a smaller number of R 4 and R 16 bodies are completed there. The R 16 car bodies are manufactured in Sandouville near Havre.

Volkswagen has its parent plant in Wolfsburg, further branches in Hannover, Osnabrück, Kassel and Emden. In Wolfsburg, the car bodies for VW 1200 and 1300 are manufactured, in Hannover, bodies for delivery vans, in Osnabrück, the sport bodies of the Karmann Ghia series, and in Emden, all other pressings are used for other types of body assembly.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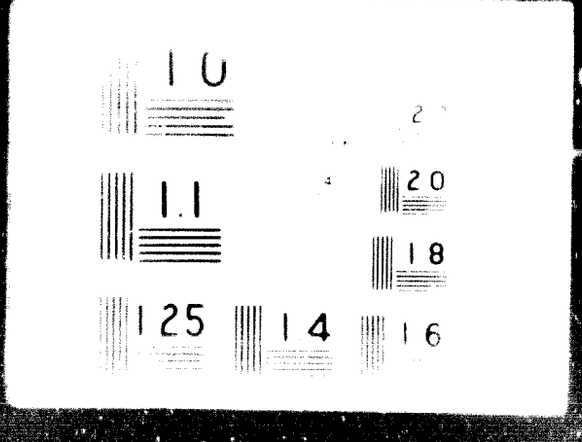

Both main European Ford plants are working under joint cooperation. The parent plant in Köln, produces the bodies of 13, 15, 17 and 20 types, his branch in Antverp, assembles these bodies from imported pressings, another branch plant in Gent in Belgium, produces the bodies of 13, 15, 17 type, for delivery vans and for English cars Ford-Escort. Another parent plant in Dagenham near London, produces the body for the cars XCortina, Zephyr and Zodiac, and his branch in Halewood, the bodies for Anglia and Escort.

Much more simple conditions exist in the cooperation of the Italian firm Fiat, producing all series bodies in his branch Mirafiore in Torino. Special bodies, i.e. coupé and cabriolets are produced by the famous Italian body shop Pininfarina and Bertone in Torino.

In big American car factories, the proportion of production, taking into account the economical transport, goes so far, that each plant consists of several independent pressing and welding shops, producing certain sub-units and sending them to the body assembly shops and car assembly shops.

Conclusion

In this proper, I have tried to point out some problems connected with the series and large series body production under European conditions, corresponding to the average in the year 1967 with respect to the outstanding productional and organizational methods.

It comes out from this conclusion, that even the most industrialized stated can not exist without a certain international cooperation. Whether it is the question of different supplies of material or car accessories, and especially, of production machinery and equipment supplies, without mention-

ing the design and plant erection with farreaching "know how". For this reason, it is necessary to put weight on these and other conditions, if the body production could be introduced in such a place, where it will depend on foreign aid, partially or completely, as it is the case in developing countries.


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