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D00182

Distr.
LIMITED

24th February 1969

ENGLISH
Original: English

United Nations Industrial Development Organization

The Seminar on the Establishment and Development of the Automotive Industry in Developing Countries

Karlovy Vary, CSSR, 24 February - 14 March 1969

THE MOTORCYCLE, ITS PRESENT AND FUTURE

by

V.Jonas

CSSR

id.69-1194

United Nations Industrial Development Organization

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ID/WG.13/18 SUMMARY*
5 August 1968

ORIGINAL: ENGLISH

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Karlovy Vary, CSSR, 14 October - 1 November 1968

THE MOTORCYCLE, ITS PRESENCE AND FUTURE[1/]

by

Vladimir Janse
Director, Technical Development Dept.
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Czechoslovak Socialist Republic

* This is a summary of a paper issued under the same title as ID/WG.13/18.

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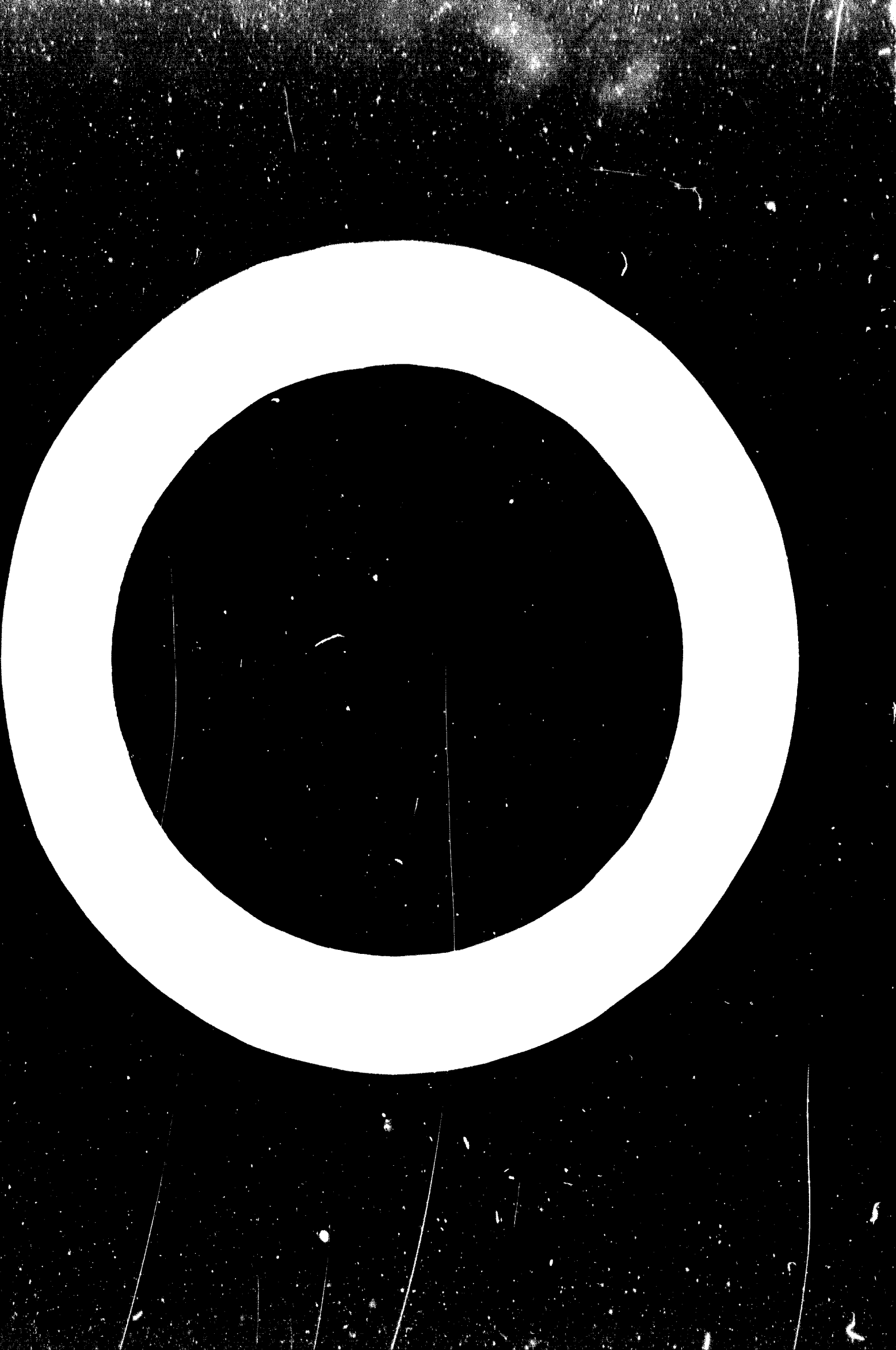

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The Motorcycle, its Presence and Future

1. Introduction:

The aim of this paper is to illustrate some economic and technological problems of the motorcycle industry /which includes, besides the classic designs all other types of single-track vehicles, rollers, scooters etc./.

2. Significance of Single Track Vehicles at Present:

The role of single track vehicles in the present motorization explosion. Single-track vehicles used as means of transport for entertainment and sport.

3. Review of Production of Single Track Motor Vehicles in the Past 15 Years:

Statistic and diagrams show the rise in production. It is typical that while the production of one type stagnates or even drops, the production of another type rises very rapidly.

4. Present State of Production of Single Track Motor Vehicles in the World, their Classification and Use:

Statistical data and graphs illustrate the present state of production according to the individual types. Classification of single track motor vehicles according to types and purpose.

5. Forecasting the Development of Single Track Motor Vehicles for the Next 20 Years:

The possible trend of development for the next 20 years as derived from the present trend of production and sales.

6. Research and Development of Single Track Motor Vehicles at Present:

The importance of research and development is stressed by growing demands upon technical specifications and performance of single track motor vehicles. A scientific approach is necessary. Strength- and life-testing of undercarriage of single track vehicles in the Jawa plant, respecting the variety of traffic demands in various countries of the world.

7. Significance of International Specifications and Agreements for the Production of Single Track Motor Vehicles:

Predetermining specifications /recommendations ISO, ECE, RVHP/
Restricting specifications /patent specifications, trade marks, design patents etc./
Existing lack of uniformity of specifications on the world scale. Recommendations for preparation of certain international specifications and standards. The purpose of interchangeability, unification and standardisation in the production of single track vehicles.

8. Significance of Single Track Vehicles in the National Economy of Developing Countries:

For the national economy of the developing countries single track vehicles play a significant role, as their moderate prices make them accessible for a majority of inhabitants. They add to the technical development of their users and to the standard of living.

9. Significance of Establishing Assembly Plants of Single Track Vehicles for The National Economy of Developing Countries:

Assembly of imported components is the first step in the industrialization of the developing countries. It gives employment to the inhabitants, serves for education of qualified and semiqualified workers. Production under license as a further step towards industrialization of the developing countries.

10. Conclusion:

Data and explanations included in this paper show that the development and production of single track motor vehicles is by no means a simple affair. It requires high skill, experience and scientific approach. All given facts prove the advantage of establishing the production of single track vehicles- starting with assembly plants and direct production of simpler component parts- for the national economy and standard of living of the inhabitants in the developing countries.

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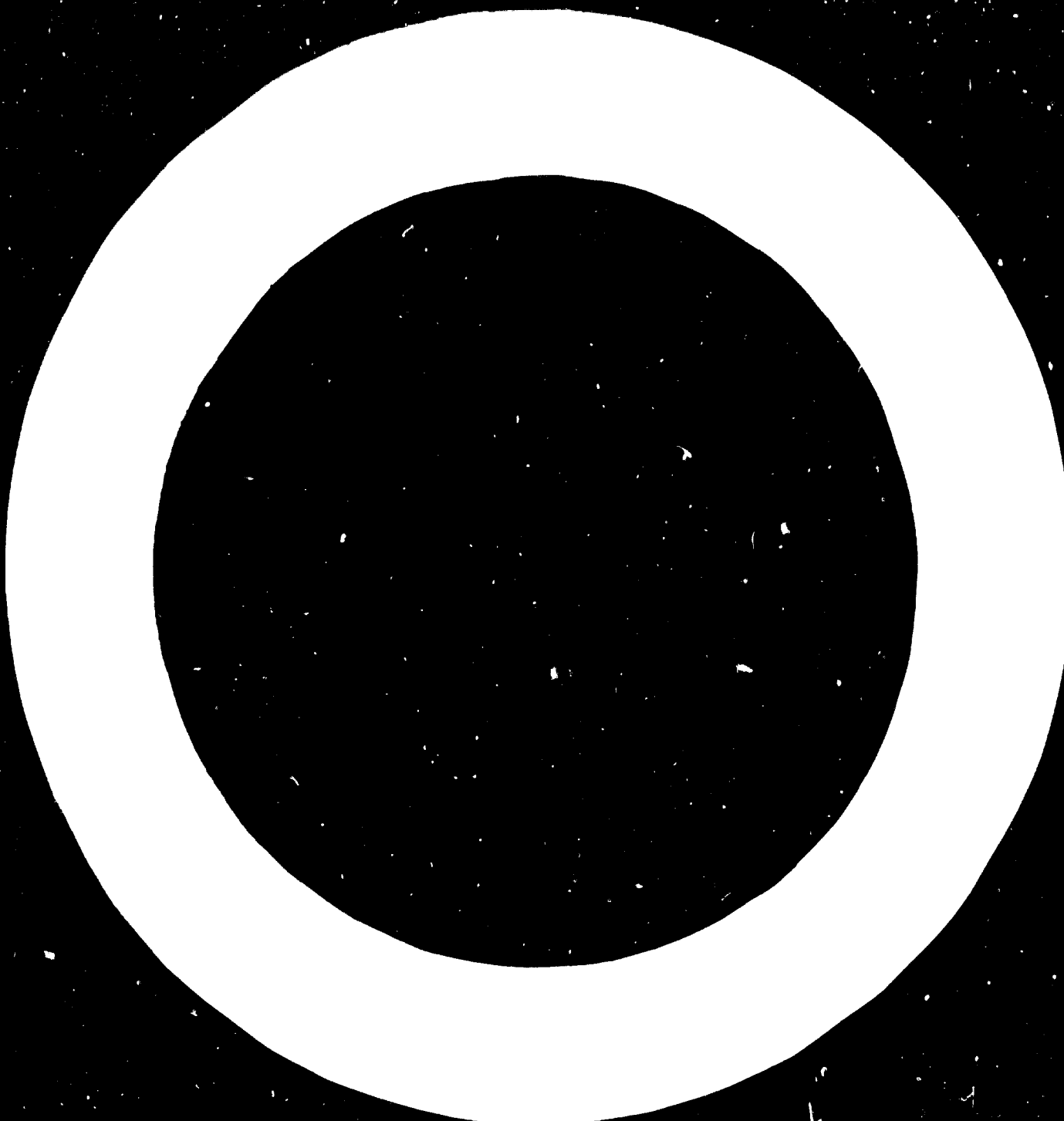
" The Motorcycle from the Aspect of the Present State and that of the Perspectives"

A Paper for the UNIDO Symposium in the CSSR-Karlovy Vary.

The Paper will be supplemented with figures and diagrams which will be projected during the reading of the Paper.

Worked out by: The Department of Scientific and Technical Development of the Research-Development Enterprise JAWA Prague .

Prague, 15th of August 1968



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Translator's Note:

In the original Czech text of the paper the word " single-track" is solely used to describe the subject of the paper, while in English the ex - pression " two-wheeled" seems to be the more proper one, more in accordance with the current use. So wherever the expression " two-wheeled" appears, it should be remembered that in Czech "single-track" has been used .

The mentioned facts, however, also point out the advantageousness of the development of two-wheeled motor vehicles production in the form of assemblies and manufacture of more simple parts for the economy and living standard of the population of the developing countries.

11. Titles of tables

1. Introduction

Several figures, providing a picture of the scope of the motorcycle production in the world and of practical use of the motorcycle, will serve as a convincing proof, that it is worth while to investigate critically the problems of motorcycle production, of the use of motorcycles and their economical contribution.

Thus:

- at present the production of motorcycles in the world varies around 7 million machines a year (in the pre - duction or export price of approx. 1 milliard US $) ,
- in the world are running approximately 50 million mo - torcycles, for which their owners have paid in purchase prices about 25 milliard US $,
- every 70th inhabitant of our planet rides a motorbike.

These are figures that speak for themselves. The values mentioned are certainly not negligible in the world economy, and naturally neither in the economies of individual countries. The fact that per each 70 inhabitants of the world there is one motorcycle, indicates that even the problem of the technical design of the motorcycle and its production is not without a decisive importance from any given aspect.

In the following parts of this paper are, in brief, explained some important economical and technical problems of the motorcycle industry. Under the term " motorcycle industry" the industrial production of all kinds of two- -wheeled, single-track vehicles motor driven, i.e. not only motorcycles, but also scooters, mopeds etc. is understood.

2. The importance of motorcycles at present

The manufacture as well as the running and maintenance of motor vehicles are very important factors of the economic activities, which to a large extent influence the living standard of the population. This fact is of such a general validity that we can hardly imagine life without motor vehicles, as well as we can hardly imagine the far reaching consequences which would take place, if all of a sudden the motor vehicles would stop to be used.

The motorcycle is and will remain to be an important means of motorization, all the world over. Because of its low price it is, in the majority of the countries of the world, a natural first individual means of motor transportation, continuing the line of non-motor means of transportation (the bicycle) and created thus in its function of a means of transportation a first step of motorization, preceding the passenger car. Through its manifold use and small demands, the motorcycle has gained even in the most developed countries - for example in the USA - a firm position even as a supplementary vehicle next to the car.

While the car serves mostly as a means of transportation, the motorcycle serves not only this purpose, but also as a means of technical education, especially that of the youth, as a means of improving the culture of life, especially that of the country population (transport to the fields, shopping, cultural events, as a means of recreation) transport to places inaccessible by car - water, woods, as a source of fun and last but not least, as a means for sporting activities, especially that of the young.

We encounter the use of motorcycle as a means of transportation not only in countries, where the population's

standard of living does not yet permit a widespread use of the automobile, as in the most developed countries with a high standard of living, but, even in countries developed very much indeed, where especially in the crowded city traffic the motorcycle proves itself to be a more advantageous vehicle, from the aspect of traffic speed as well as from the aspect of easy parking.

As far as the developing countries are concerned, the decisive factor, naturally, is the low purchasing price and the easy maintenance of the motorcycle as an advantage over the automobile.

The stated facts clearly show that the growth of motorization will, even in the future, be realized through the increase of number of motorcycles same as that of automobiles.

3. Survey of the development of the motorcycle production in the past 15 years.

If we take as a starting point the year 1951, as a more normal one, already less influenced by the lack of motor vehicles due to the war, we can see:

From the diagram No.1, that up to the year 1966, i.e. in the course of 15 years, the production of motorcycles in the world has increased from almost 2 million to roughly 7 million, that is almost 3 1/2 times. The diagram No.1 also shows a steep trend of production growth from the year 1951 till the year 1961 (from almost 2 million to 6,6 million, that is to more than three times as much), a mild stagnation in the period 1961 - 1964 caused by a number of circumstances, especially also by limiting clauses of traffic regulations (introduction of obligatory

driving licences even for drivers of the smallest ve - hicles etc.) in a number of European countries, and a repeated growth in the period 1964 - 1966 (approx. 10 %).

Diagram No. 2 illustrates then the fact that if in a given year the production of one kind stagnates or even shows a decline, the stagnation or decline are soon com - pensated by the production growth of another type of a two- wheeled motor vehicle. This variation can be explained on one hand by the growing standard of living and due to that by the changing needs of users in the course of time, on the other hand, to a large extent, by the low price of small cars and the following increase of their number and due to this again, by the low price of used cars, and finally to a certain extent by the influence of fashion.

As an example, it can be mentioned, that naturally in a certain period the interest in heavy, de- luxe motorcycles has dropped, as their price was practically equal to the price of a small car, while their relative value of use is incomparable in favour of the automobile. But simul - taneously with the growing interest in a cheap small car has grown even the interest in a cheap small motorcycle , as the simplest and cheapest motor means of transporta - tion.

As another example, it can be mentioned, that in the most developed countries with the highest living standard of the population, where the car has become a natural subject of daily use, even a need of a not exactly cheap motor - cycle has been observed, as an object serving for the fun of the owner of one or even more cars. The explana - tion of this phenomenon can be found in the fact, that a first hand joy of driving a powerful motorcycle is for many people, especially the younger ones, incomparably higher then the joy of driving a powerful and ever-so-com- fortable car, as well as in the fact, that on the motor - cycle one can easily reach places distant from the motor

vehicles traffic, for example forrest and field lanes, which is not possible with a car.

A picture of the changing need is provided by a comparison table of production composition in the years 1961 and in the year 1966 of the Japanese motorcycle industry, which through its dynamics proves a high ability to adapt itself to the changing need.

JAPAN	1961	1966
50 ccm	1,400,000	914,000
51- 125 ccm	305,000	1,225,000
126 - 250 ccm	141,000	170,000
over 250 ccm	3,000	98,000
scooters	100,000	34,000
	1,949,000	2,447,000

The table shows, that the total production of motorcycles has increased in the year 1966 as against the year 1961 by approx. 26 per cent. At the same time the proportion of machines of those of the (smaller) volume class of 50 ccm out of the total production has declined from 72 per cent to 30 per cent, the proportion of machines of volume classes of 51 - 125 ccm has grown from 16 per cent to 50 per cent, the proportion of machines of volume classes of 126 - 250 ccm remained practically without any change, while the proportion of machines of the volume classes over 250 ccm increased from 0,2 per cent to 4 per cent. In accordance with the world trend the part of scooters of the total production has dropped from 5 per cent to 1 per cent.

It is also worth mentioning, that with the intense production growth of the Japanese motorcycle industry the proportion of scooters in the total production of two -

- wheeled motor vehicles was falling down since the year [illegible], when it was 52 per cent (13 thousand scooters), to [illegible] per cent (55 thousand scooters) in 1956, to 5 per cent [illegible] thousand scooters) in the year 1961 and to approx. [illegible] per cent (34 thousand scooters) in the year 1966.

4. The present state of production of motorcycles in the world - their division and use

4.1. Production

The survey of the total world motorcycle production in the year 1966 and its composition, divided into machines up to and above 100 ccm is illustrated by the diagram No. 3. In the diagram it can be observed, that of the total production of approx. 7 million machines, the machines of the volume classes up to 100 ccm [illegible] up 67 per cent, the machines of volume classes above 100 ccm 33 per cent.

The biggest production countries, are of the capitalist countries, Japan and France, and of the socialist countries the USSR. Japan manufactures for example approx. 2,5 million machines annually. The production of the following seven countries varies from 100 thousand up to 500 thousand to 600 thousand machines per annum. The part of developing countries in the world production represents about 1,5 per cent (over 100 thousand out of 7 million).

In the course of the past 15 years, similarly as in other industrial branches, and because of the same causes, a considerable concentration of production has occurred, and that both in countries where the production has dropped (for example the GFR and Great Britain) and in countries where it has maintained the,

same level (for example France or Italy) or increased (for example Japan). So in the GFR the number of manufacturers has fallen from more than 60 to practically 3, in Great Britain from several tens has remained only one important one, similarly in France 3 and in Japan 6 .

In spite of that, still some 125 manufacturers are undertaking motorcycle production in the world. But only with about 22 of them the capacity exceeds the annual production of 100 thousand machines. The remaining more than a 100 manufacturers are mostly performing the assembly of motorcycles from components mainly bought out from specialised manufacturers.

4.2. Export

From the point of view of larger manufacturers the motorcycles are an important article of export. The world export has increased from the year 1951 - 1966 almost 8 times and reached approximately 4, 8 million machines in the value of about 92 million US $. Buyers are the developed and developing countries.

4.3. Numbers of motorcycles in service and the density (number of motorcycles per 1000 inhabitants) in the world.

Diagram No. 4 provides a survey:

a) of the total population in the year 1956, of the number of motorcycles in service, of the number of cars in service, of the population ineligible (because of age) of driving motor vehicles and of the number of potential buyers of a motorcycle. These data are apparent from the first part of the diagram from which it follows, that in the world - the population in the year 1956 was 3,5 milliard

- the number of motorcycles in service was approx. 50 million
- the number of cars in service was approx. 150 million and
- the number of potential motorcycle buyers was 2 milliards

In the following diagram No.5, in the columns, the comparison is illustrated of

- the annual motorcycle production in millions of pieces in the years 1951 and 1966
- the population in milliards in the years 1951 and 1966
- the number of motorcycles in service in the years 1951 and 1966 and
- the density (number of motorcycles per thousand inhabitants) in the years 1951 and 1966

Generally it can be said, that between the trend of population growth and between the trend of increase of the number of motorcycles in service and their production, there is not a direct connection. But in the same way it can be stated, in general, that there is a connection with respect to the possible development of personal incomes in individual geographical areas or countries.

The comparison data in the diagram do not need any special commentary.

Deviations from the direct connection between the population growth trend and the trend of increase of motorcycles in service can be explained, in principle, by these facts (correction factors) :

a) a low density of individual transportation means in the year 1951 and from there following hunger on the market for any means of transport, as a result of the IInd World War,

b) a rapid growth of population in the developing countries especially in those with a very low standard of living,

c) a later rapid increase in car production and their numbers in service in the world,

d) a large non-uniformity in density of motorcycles, reached in the year 1966 due to considerable differences in the living standard in separate geographical areas or individual countries.

The first three of the mentioned correction factors do not require a more detailed explanation, as for the last one, it is necessary to add in a brief summary rougly this:

The world can be divided, very roughly, into four groups of countries according to the density of motorcycles, in the following way:

A) Countries with density up to 15 inhabitants (1 motorcycle

Into this group belong very varied countries with densities ranging from 5 to 15 inhabitants per 1 motorcycle and with automobile densities still more varied. Into this group belong for example France, Sweden, Holland, Austria, Italy, Belgium, Switzerland, Japan and other.

The analysis which according to the motorcycles and automobiles density, as well as the standard of living and the price level would require a further division of countries into individual subgroups is here, for the sake of brevity, not carried out.

A common characteristic of all these countries is an approximate saturation of the market by motorcycles.

B) Countries with density of 15-50 inhabitants / 1 motorcycle

Even in this group very varied countries are included, and that what was mentioned for the group A is valid here, too. Herein belong countries like the German Federal Republic, Great Britain, Denmark, Norway, Finland, Spain.

In several countries of this group the motorcycle market is not yet saturated as for example in Spain, perhaps even in other countries.

C) Countries with density 50-500 inhabitants / 1 motorcycle but with the highest automobile density

Into this group of countries belong namely the USA, Canada, New Zealand and Australia.

Their common characteristic is, that in the last years the demand for motorcycles is growing on the unsaturated market.

D) Countries with density of 50 - more than 5000 inhabitants / 1 motorcycle

Into this group of countries belong all countries with a low standard of living of wider population strata. These countries represent the main future market outlet of motorcycles as well as of automobiles with gradually increasing living standard of their population.

4.4. Division of motorcycles according to types and their use

In the times before the 2nd World War the motorcycles were divided into light and heavy ones, while into the group of light motorcycles were included machines with engines up to the volume of 250 ccm, machines with en-

of factors unknown at the time, when the prediction is being made.

Naturally, as forecasts in any sphere of human activity can be made, without starting from a thorough knowledge of the development in the past and from an analysis of influences, which influenced the development of the given activity. It is also, therefore, not possible to approach the prognosis of the probable development of production and of the number of motorcycles, without such a knowledge and analysis.

The picture of the development in the preceding 15 years, i.e. in the period from the year 1951 to 1966, as well as the analysis of its causes was presented in the preceding chapter. Before approaching the considerations of the perspectives, however, it is still necessary to make a brief recapitulation of the past period.

From the analyses mentioned in the preceding chapter, it followed that while the population of the world has grown by 46 per cent, the production has increased by more than 265 per cent, the number of motorcycles in service by 400 per cent and the density by 247 per cent. It was mentioned that the rapid growth was influenced by factors, which were of a temporary character, which were not acting any more in the last years of this past period. This is obvious from the production growth trend illustrated in diagram No. 1, while in the period 1956 to 1961 the production of motorcycles in the world has increased by 54 per cent, the production increment in the period 1961 to 1966 was only 6 per cent.

Let us approach now, starting from the analysis of the preceding period, and taking into consideration all specific features of different geographical areas of the world, the consideration of the probable development trend of the production of motorcycles and of their number from the year 1966 to the year 1980.

After weighing all the circumstances and probable influences and considering all trends manifested in the period of the past 5 years, it is possible to state that the motorcycle production will rise from the present 7 million machines to approximately 7 1/2 million in the year 1970, almost 8 million in the year 1975 and almost 8,5 million in the year 1980. This increase of production represents an increment of about 20 per cent as against the present state.

In order to get the increase of total numbers of motorcycles and thus even the increase of density in the world, we must yet consider the service life of the motorcycle and determine through a consideration what part of the increment will be used for renewal of the present motorcycle fleet and what part will be the actual increment.

It is known from experience that in developed European countries the service-life of motorcycles with very good maintenance, and if used in good weather only, reaches at best 10 years. In countries where the motorcycle does not serve as a means of transport but for fun, the service-life or rather the time till its discarded is considerably shorter with respect to the high purchasing power of the users. In the same way the service-life of a motorcycle is shorter in developing countries due to less perfect maintenance and less skilled handling. Nevertheless, let us consider for our poognosis, to be on the safe side, a service life of 10 years and then we will get these results. Out of the production of approx. 7,5 million in the year 1970 the annual renewal of the state will take up some 5,5 million and the annual increment of the state some 2 million, so that the total state will reach some 56,6 million of motorcycles; the probable situation in the year 1975 will be such, that out of the total production of some 8 million machines, the renewal will take up 6.3 million and the increment being 1,6 million, the total state in the year 1975 will be some 65 million motorcycles.

Similarly in the year 1980, out of the estimated production volume of 5,5 million motorcycles the renewal will take up somewhat over 3 million and about 1,2 million will be the increment. The total number of motorcycles in service in the year 1980 should reach, according to this consideration, approx. 15 million machines. The details are illustrated in Figure No. 5.

The production growth trend determined in this way through a consideration is in the period 1965 - 1980 20 per cent, the trend of increase in number of motorcycles 14 per cent, which with the assumed growth of population by 29 per cent represents an increase of density from the present 70 to 62,5 persons/1 motorcycle, i.e. by 12 per cent.

A comparison with trends of the past period shows that the trends determined for the next period appear to be realistic and rather lower than they will probably be in reality.

Diagram No. 7 shows the production volume in the year 1980, the part which will be used for the renewal of the motorcycle park and the part which will make up the increment according to above mentioned data.

6. Research and development of two-wheeled motor vehicles of present

If we follow the development of the research departments of enterprises manufacturing motor vehicles in the last, for example twenty years, we will find that its trend is unambiguous. It is characterized, quite lawfully, by a continuous growth of these departments, and in all main parameters, which we can follow.

To be specific, for example, the financial outlays for them are growing in absolute as well as relative figures, numbers of people employed there are growing, the level of their technical equipment is increasing qualitatively as well as

quantitatively etc. If we further compare the development of research departments with the development of the design-development departments (while both these kinds of departments belong into a common research-development basis of the enterprise) it appears that while the trend of the first (research) is, as it has been already indicated, rising and sometimes very markedly rising, the trend of the second (design) is not characterized by this activity. For example , the numbers of employees in the design departments remain approximately constant or they change only little. Let us try to explain this fact more in detail.

Technical (but even other) parametres of two-wheeled motor vehicles have, as it will be shown, if we follow their development more closely , a constantly increasing tendency. The main reason, causing this fact, is the constant growth of demands placed on these vehicles, which is caused by a mutual combination of an association of individual, group and whole-society interests. Even commercial interests force the manufacturer to improve the parametres, as the vehicle, the properties of which are of good (better still, top) technical level, is better able to prove itself in the competition with vehicles of other manufacturers. It is certainly not necessary to stress that if the manufacturer wants to be successful on the market, he must unconditionally respect the indicated trend and his effort must be the best possible parametres of his products.

With the previous (at present already historical) way of motor vehicles development, its technical level was being decided primarily at the designing stage, and their level was based, first of all, on the technical inventiveness and imaginativeness of the designers. Even nowadays this stage of development is important, but far from being sufficient. At present, the ensuring of the vehicle's parametres even on an average (and the more on a peak) level is quite unthinkable without the collaboration of departments of a research character. But not only that. In ensuring some main parametres of the vehicles, concerning

for example the performance, engine torsion moment and fuel consumption, dynamic properties of the vehicle, sound level etc., the research departments take even a prevailing, decisive part.

The main tasks of these departments are, briefly, about these:

- they solve technical problems of perspective importance, before all such, where it is assumed that their solution would be an important contribution to the technical-economical side of the vehicles in the near or more distant future (scientific, explorer research). Research of this character enlightens and makes easier the ways of future development, discloses possibilities and creates preconditions for progress in the given technical sphere and improves even the methods of research. Manufacturers who have in mind their application in future cannot do without it.
- they must find the most optimum design of vehicles in their development. It is a very important work which must progress confidently quickly (as well as being an early start-up of new types), but it requires of the same time persistence and thoroughness. Research of this kind usually requires the main part of the test capacity of the research departments of the factories and we will mention it in detail later on.
- they help departments of technical inspection in ensuring the quality of vehicles already manufactured, by solving test tasks of a special or extraordinary character. Not even this task can be overestimated, as the level of its ensuring co-decides on the sales of products and the good name of the manufacturer.

The solution of the above-mentioned tasks of the research departments requires, if it has to be successful, a good and sufficiently fast, highly expert (often scientific) approach to work, experience of long years standing and a

corresponding material and technical equipment. The tasks are being solved by different methods: theoretically, experimentally and by a combination of these ways.

Research work cannot be carried out without a necessary testing equipment (testing stands, gauging apparatusses etc.). This equipment is manufactured by specialized firms (as far as equipment of universal character is concerned). Often, however, when their character is higly special, the research departments have to design and manufacture them themselves. The testing equipment is almost without an exception costly and if the result of measurements should be reliable, it requires skilled handling. Lately, the research departments are being equipped even with computers which considerably speed up the calculations and improve the quality of research work. The computers are able, for example, to calculate in a short time a large number of possible alternative solutions of problems and enable thus the determination of the optimum one of them.

Let us consider, in further, somewhat deeper, the requirements, placed on the motor vehicles. In individual interpretation, their sum creates, with man as a subject, a definitie structure. In order to make the man value the vehicle as a subject of his, be it higher or lesser, interest positively it is necessary that the vehicle would fulfil his requirements in the highest measure, as far as possible.

The manufacturer, of course, does not develop and manufacture consume vehicles individually according to the wishes of each customer. He manufactures in series, that means that at least a certain number of them must have the same appearance. The situation is made somewhat easier by the fact, that the existing concrete structures of individuals requirements can be for practical satisfying, divided into (a larger or smaller number of) groups. Into each of these, individual structures, which are more or less near to each other, can be included. The structure of each

such group structure of requirements then (with a compromise) fulfills the requirements of a certain group of customers .,

The main precondition for the product, in our case a motor vehicle (=motorcycle), to be successful in practical use as well as from the aspect of sale lies in the estimate of customers' requirements structures, the selection of structures of customers' groups, the interest of which the manufacturer wants to satisfy, and in the technical fulfilment of requirements according to selected structures by the product being developed (with perhaps the respective alternatives of the basic type) .

With respect to the aim of this UNIDO symposium it is necessary to underline, that the differences of structures of requirements placed on motor vehicles does not consist in subjectively individual causes only, but not in a lesser extent even in causes of the objective environment. Concretely, for example, the climatic influences, differences in service conditions in different countries are of influence. Some of them will be discussed later.

Already at this point however, it is necessary to stress, that the differences in service conditions in different areas are in some respects very considerable and they have to be taken into consideration when developing the vehicles. It is necessary to start from real service conditions and from the real kind of use even when deciding whether a certain kind and type of the vehicle is suitable for exploitation in a given country. Not each vehicle is suitable for each purpose and for all service conditions. Dangers which could follow the not respecting of this seemingly natural recommendation are serious. For example some parameters of the vehicle might deteriorate, break - downs, accidents, excess wear and shortening of the service-life of parts and even of the machines as a whole might occur, etc. - all this has unpleasant consequences for the manufacturer, economical ones as well as in sales.

As it has been already mentioned, the task to find the optimum design of the vehicle in the stage of its development is worked on by the research departments. The optimum technical design of the vehicle, apart from other, assumes that

- its principal, important parts will be in no way under - dimensioned, that means that during their service no failure of theirs will occur, no excess wear, impermissible drop of parameters and so forth and that
- its parts will neither be overdimensioned, because then an unnecessary increase of production costs and a damage to a number of technical and economical parameters (for example its weight, price etc.) take place.

The optimum design must be (as already outlined) considered with respect to the assumed service conditions. A certain actual vehicle can appear to be very well satisfactory for a certain service area and purpose, while for another one it will be unsatisfactory and so forth.

After the preceding necessary explanations, in the introduction of this chapter, let us consider the problems of two-wheeled motor vehicles research somewhat more in detail and more concretely. Research work, which is carried out during their development concerns

- engine blocks (engine units, i.e. engines incl. the suction and exhaust systems and gears),
- chassis (incl.springing, brakes etc.) and
- accessories.

To discuss in detail the problems of all mentioned groups of motorcycles is above the scope and purpose of this paper. In further, therefore, as an example of the necessary wide scope of tests, we will discuss more in detail the problems of chassis, and that only from a partial aspect of the research of strength and service-life of their main bearer

parts. We will not concern ourselves with explaining the problems of these tests in detail, but with showing on their example that the matter is comparatively complicated, laborious and responsible.

In the Research Development Works of the Jawa factory the strength and service-life tests of main bearing parts of chassis (by these parts we mean first of all the frame, the front and rear fork) performed during the development of new types of vehicles have these stages:

a) static gauging of rigidity,
b) determination of stresses under different service situations,
c) laboratory service-life tests,
d) service-life tests in real service.

Static gauging of rigidity has to enable preliminary exact evaluation, whether the rigidity of the chassis being developed is sufficient. Rigidity is an important property of the chassis, as it co-decides such properties of the vehicle, as it manoeuvreability, stability and safety.

The tests are carried out in a laboratory, and that on complete vehicles or on their main bearer parts separately. During the test of whole vehicle rigidity, the vehicle is clamped in a special fixture and it is loaded by forces and moments in the main coordinate planes. The result of measurements are evaluated on the basis of comparison with corresponding values obtained by testing of other proved comparable vehicles. Results of laboratory evaluation are later being compared even with subjective testimonials of test drivers, obtained during driving tests.

The next stage of tests is the determination of stresses under different service situations. There exists a number of influences causing stresses of chassis in service. During service they are combined in different ways and their effects are superimposed. Stresses which occur during service in the main bearing parts of the chassis can manifest them-

selves in an unfavourable way mainly in three ways:

- the elasticity limit can be exceeded in a certain point and due to that a permanent deformation of the bearer part will take place.
- the strength limit can be exceeded in a certain point and due to that the destruction of the bearer part will occur.
- with a frequent exceeding of the fatigue limit in a certain point the destruction of the bearer part may also take place due to fatigue damage of the material.

All these three unfavourable and dangerous possibilities must be prevented in advance by a proper testing of the design. We will briefly mention how these tests are being carried out in the Jawa works.

It was already stated, that the stressing of bearer parts in service is brought about by a number of influences. Concretely, they are mainly the following influences:

- weight of the vehicle,
- weight of the rider (or riders) and perhaps that of baggage,
- resistante of rolling,
- resistance of air,
- resistance of acceleration,
- grade resistance,
- braking,
- unbalanced engine forces,
- dynamic forces, due to unevenness of the roadwork.

The research department of the Jawa works has worked out a method by which it is possible to determine the stresses, caused in any given point of the chassis by individual influences of those mentioned, and it has carried out a large number of measurements with different two-wheeled motor (and non-motor) vehicles, in order to determine, which of these influences are, from the aspect of strength and

service-life, the most important ones. For the measurements the department uses electric and mechanical tensiometers. Mostly it is measured by the method of electric resistance tensiometers, and according to need apparatuses of Czechoslovak and foreign manufacture are being used. The method of determination of stresses, caused by individual influences mentioned is briefly about this :

Stresses caused by the weight of the vehicle are determined by means of a so called method of unit stresses. As it will be mentioned further, this method is suitable even for investigating other of the influences mentioned. It has a number of advantages. It is quick enough, it can be applied by means of tensiometric apparatuses and comparatively simple devices in the laboratory and it enables to calculate stresses caused by a certain influence in the whole possible service range. This method cannot be described more in detail in this paper, it will, however, be published in technical press.

Stresses caused by the weight of the rider (or riders and possible luggage) are determined by direct measurements on the driver's or duriers mounting, or possibly on loading of the luggage. By superposition of stresses caused by the preceding two influences the so called static pre-stresses are being determined, again for the vehicle occupied by one or two riders. Stresses caused by the rolling resistance are also determined laboratorily, by a method developed by the Department, too.

Stresses due to air resistance are not determined currently as their measurement is , with the method used, comparatively costly and at the same time these stresses are very small, so that they are not decisive for the strength and service-life of the bearer parts. In case of need they are determined by direct measurement on the actual vehicle (with a rider, or even a co-rider) in the aerodynamic tunnel.

Stresses due to acceleration resistance and grade resistance

are again determined laboratorily by the mentioned method of unit stresses.

Stresses due to braking are also determined by the method of unit stresses, and that always for cases of braking with only the front brake, only with the rear brake and with both brakes simultaneously. In this and in the preceding two cases (i.e. acceleration and ascending) always the case of one and two riders is considered. As three mentioned cases of braking are investigated because in individual measured points of the chassis the maximum stresses due to braking occur in different ones of them.

Stresses due to unbalanced engine forces are determined by direct measurement during the running of the vehicle on the test roller bench, and at different speeds of travel (engine revolutions).

Stresses brought about by dynamic forces caused by unevennesses of the roadwork are determined by direct measurement during the travel of the vehicle over the road. The test department has, for this purpose, a special gauging car in which the gauging apparatuses and the respective personnel are stationed. During the measurements the car is connected with the measured vehicle by a cable and the stresses are recorded by a moving-coil oscillograph onto registration paper. The measurements are currently carried out on roads with different surfaces and at different speeds of travel. The obtained courses of stresses are evaluated on one hand from the aspect of maximum service stresses occurrence on the other hand from the aspect of transient frequency for each of the measured sections.

As it has been proved by a number of measurements the rolling resistance, air resistance and the unbalanced engine forces are for the strength and service-life of the main bearer engine parts of lesser importance. Also the acceleration and grade resistances do not have a considerable influence in this respect. Thus, in usual cases the atten-

tion at tests is concentrated on the influence of:

- static transverse,
- braking and
- dynamic forces, caused by unevennesses of roadway.

Static transverse accelerations are usually not very large, but their investigation is needed as they are superimposed over stresses caused by other service influences and apart from that they enable to analyse the basic character of the chassis stress-state.

Stresses caused by braking are usually the highest of all stresses caused by the followed influences. Their absolute magnitudes are often such, that in fact the elasticity limit or even strength limits of the materials used can be exceeded. We consider, therefore, the investigation of their extreme values as necessary. The highest possible values are, apart from other, dependent on the adhesion coefficient, which is at disposal between the tyres and the road surface. This coefficient has high values on high quality roadway with concrete or bitumen surface. From this follows that the danger of damage to bearer parts of chassis due to braking exists primarily in countries with high-quality roads network, and the more so, as on such roads the vehicles are being used at high speeds of travel and are often intensively braked from these speeds. If we consider stresses caused by braking from the aspect of magnitude and frequency of other stresses, then they are high but rather isolated.

Stresses caused by dynamic forces, due to road unevennesses are usually of lower extreme values than stresses due to braking but their frequency is high and they are, therefore, decisive for the service-life of the main bearer parts of the chassis. The magnitude of service stresses is dependent on one hand on the speed of travel and on the other hand on the road surfaces, as far as the height of unevennesses is concerned, their sequence and character. The influence

of roads surface is very considerable and it is neces - sary, therefore, to take into consideration, when developing a vehicle, the composition of the roads network on which the vehicle will be used. It is self-evident that the differences in the roads network must be well considered even when deciding whether the vehicle is suitable for exploitation in conditions of individual countries of export. Sometimes this is done not only on the basis of more reports on the roads-network of a certain country, but on the basis of measuring unevennesses of its typical roads. The research department of Jawa uses for this purpose several methods of measurement and has gained in this respect a number of valuable data and experience.

While the analysis of stresses determined by means of the outlined method from the aspect of possible exceeding of the stress at the elasticity limit or at the strength limit is not particularly difficult, their analysis from the aspect of fatigue strength requires further tests to be carried out. As it has been already mentioned, these are either laboratory tests or tests in real service. First, we will briefly outline how the first of them are being carried out in Jawa .

Laboratory service-life tests have a long standing tradition in the factory and the research department has a lot of experience with them. Their carrying out followed from pressing practical needs and from the realization of the fact, that without them it is not possible to reach sufficiently quickly the optimum design of the chassis of the vehicles being developed. The service-life of ma - chine parts namely, is a complicated matter and it is influenced by a number of factors, which up to now cannot be considered sufficiently exactly. For illustration sake let us name at least the influence of dimensions and shapes of the structural part, material and technology used, human factor in production, tolerance in dimensions and properties of the material used and even in technology

The equipment can run permanently in a three-shift operation so that the tests are very much speeded up. Its advantage is even that, that it can be used for testing under the same conditions even in case of unfavourable weather, for example in the winter period.

Torsiontable stands, called also "artificial roads", are suitable for testing of function samples of motorvehicles and prototypes of these vehicles and that, for testing their properties as a whole. Their advantage is that in this case not only main bearer parts of the chassis, for example the frame, are being subjected to tests, but even other parts, first of all cover sheets, wheel springing, tank, electric set, connecting parts and other. Tests on the torsiontable stand cannot replace climatic service-life tests, neither vice-versa. Both kinds of laboratory tests supplement each other.

The final stage of chassis strength and service-life tests are test in real service. Chassis are being tested here in the frame-work of driving tests of vehicles (function samples, prototypes). These tests consist in driving of a certain mileage over a fixed route, under more closely specified conditions. The length of the route the vehicle has to travel is regulated by the kind and purpose and the engine volume and reach a 50,000 km, often even more. The aim of these tests is already not the development of the chassis main bearer parts from the aspect of its principal design (i.e. as far as the selected structure system, main dimensions, material and production technology are concerned) as this part of the job has already been done in the previous stages. The driving tests have only to prove that these main parts have been, from the aspect of fetigue strength, correctly dimensioned. But their further aim is, as far as the chassis bearer part is concerned to analyse even the strength of other (not only its main) parts (even non-metallic ones) their reliability even in periods of long duration, need of maintenance, durability of cover assembly operations and a number of other aspects.

It is obvious, that even with driving tests, peculiarities of vehicle service in areas for which the vehicle is determined, have to be taken into consideration. Here are manifested the differences in travelling speeds and especially in the composition and quality of the network of roads. In countries, where the roadways are exceptionally bad, it is recommended to carry out service tests of several vehicles right in the local conditions.

After this brief description of kinds of different tests of chassis bearer parts as they are carried out by the [illegible] factory research department let us add a few [illegible] remarks. We have mentioned that a thorough testing of chassis (and let us add: obviously even of other parts of the vehicle) in their development and their check [illegible] during production in series is necessary and that the not respecting of this principle brings serious dangers to the manufacturer.

As an example let us assume that in the development the frame would be, from the aspect of [illegible] insufficiently designed and badly tested and the production in series of vehicles of which it would be a part would then start. The defects in the frames would not become apparent right away. The vehicles after being finished must pass through the despatch department, they are transported to the place of destination and are not immediately bought by the customer- this all requires a certain time. Even in service the break- down need not occur at once: the formation of fracture in an underdimensioned structure assumes travelling of, for example, approx. 3.000 to 5.000 km (this apart from other depends on conditions of service) which with an average user assumes, for instance, a year of use. On the whole, the occurrence of the defect may take place even after a longer time and in the meantime a large number of products will have been produced (more time still, of course, is necessarily taken up by the recommendation of suitable measures to remove the defects, and by their realization in production). It is not necessary to prove, what unpleasant a situation would arise for the manufacturer

under these circumstances, even if the defects would occur only in one per cent of the products - let us consider only the costs of new spares production, their transport into repair-shops, assembly etc., damage to the brand name and clientele. The same situation would arise even with products dimensioned correctly but for a certain area and used without investigating the suitability in an area with much more difficult conditions of service.

We have, at least in main features, outlined the problems of research and development of two-wheeled vehicles on the example of main bearer parts of chassis. Similar, more or less complex problems arise in the development of driving units (engines), gears, other chassis parts (for example springing and brakes) and equipment. What here proper and expert testing is desirable and necessary. Each of the mentioned parts has, of course, its own special problems, which are reflected in the content of the tests, testing methods etc. As an example, at least three tests can be mentioned - in spite of existence of several groups of international unification of test methods and permitted sound levels, the method of testing in different countries of the world is not unified and even the permitted sound levels for individual countries are different. There is nothing else left for the manufacturers of two-wheeled vehicles than to respect this complicated situation and to test vehicles accordingly to certain needs of individual countries into which they export. It is a difficult task and it requires, apart from other things, an extensive knowledge of the texts of notes regulations in these countries.

This chapter has not made it's aim to acquaint in detail with problems of two-wheeled motor vehicle testing, as this task is beyond the scope and purpose of this paper. The intent was only to point out briefly, summed up into the following conclusions:

- Development and research of two-wheeled motor vehicles is, at present, a complicated matter, which requires,

apart from other, considerable expenses, sufficient working capacity, testing equipment, verified test methods and not in the last place even experience of long standing.

- Successful solution of the problems outlined, requires a highly expert, often scientific approach.
- When developing and testing vehicles, it is unconditionally necessary to respect service conditions under which the vehicle will be used.
- These conditions must be respected even when deciding which vehicle should be exported into developing countries, or possibly manufactured there.

7. The importance of international regulations and agreements on vehicles execution in the motorcycle branch .

The International Organization for standardization ISO which should ensure the development of standardization on the whole world and thus increase the international exchange of goods and possibilities of scientific and technical cooperation has not yet considered the problems of the two-wheeled motor vehicles production sphere in a separate expert commission . The solution of some standardization problems, however, was brought through results of some commissions activity, for example ISO/TC 22 - Automobiles, ISO/TC 31 - Tyres, rims valves, ISO/TC 100 - Chains and chain wheels.

Regulations and rules of international motorcycle competitions and races (FIM) are the basis of typification of two - - wheeled motor vehicles volume classes and this has been reflected in international and national insurance and tax regulations.

Lately, the production of two-wheeled motor vehicles is more and more markedly influenced by the negotiated documents

of the ECE, by which requirements concerning the service of vehicles are determined (brakes, lights, screening, noiselessness, outlet of exhaust gases and others).

An obvious effect of systematic control of standardization problems on an international level is the developing activity of the Permanent Commission for Standardization working with CMEA (TKS). In the prepared document of December 1967 the analysis of the state of two-wheeled motor vehicles branches standardization in the countries of CMEA has been carried out, and also in some other countries (Finland, France, Italy and others). The identity of a number of titles of standards and mostly even of their contents outlines a wide field of possibilities not yet made use of in international standards validity (for example rims - tyres, wire spokes and their nuts, bowdens and connected parts, accumulators).

The formation of some international standards can be, on the whole, described as a pressing need. They concerne primarily unified locations of control elements on the vehicle, as the present standards are manifesting considerable differences. Of great use might be even the publishing of terminological international standard a multilanguage one, which would facilitat international negotiations and which would increase the whole world survey. A documen. of this kind has already been worked out, but it was distributed only to national bodies which have their representatives in the FIM organization (Federation International Motocycliste).

The gradualy more and more clear requirements on the basic vehicles execution provide a pre-condition for the qualification of standards of general technical requirements , which would respect international recommendations and regulations, or possibly peculiarities of national regulations and standards. Onto the formation of these standards analogically conclude evaluation and testing standards . The gradual elaboration of the mentioned projects in

national standards creates, for the near future, a pre - condition for the formation of international standards, the existence of which will enable an objective vehicles analysis and their mutual comparing.

The validity of standardization, unification and typifi - cation cannot be characterized only by the number of valid standards, but first of all, by results achieved in produc - tion economy. For example : In determining a suitable type series of vehicles, it is possible to achieve a wider list of final products without a considerable production costs increase through a suitable unification of parts and as - sembly units.

It follows from the outlined that the achievement of the highest technical, economical and international level is closely connected with correct application of technical standardization. An effective application of standardiza - tion from the very beginning of production development of any branch provides conditions of its accelerated development.

Similarly as all creative activities the aim of which is technical progress, even the development of new motor - cycle types or elements requires that the creative workers would start from the known state of technique and from the knowledge of the scope of existing protective laws (pa - tents, protected models etc.) of the field.

The mentioned protected rights must be respected, otherwise there is the danger that the owner of the protected right will proceed against the offender with far reaching con - sequences.

These might take the form of production prohibiton or prohibition of the products propagation, of damages etc.

The protected right - patent, protected model etc. - has that effect, that no one is allowed to exploit, with some exceptions, the subject of the protected right without the

approval of its owner or of that one onto whom the right to grant approval was transferred. The protected right have a solely territorial character, that means, that they are valid on the territory of the country where they are registered according to valid acts of law. This fact leads to that, that large manufacturers have their protected rights registered not only in their own country, but also in a number of other countries according to their interests, that is on one hand in countries which represent existing or potential markets for them and on the other hand in countries where their competitors are resident. The scope of protected rights is considerable and it increases proportionally with the development of science and technique.

This forces important manufacturers to follow carefully protected rights newly registered in their own field as well as in related ones. They must, therefore, have their own information service which collects information on new protected rights and it points these out to creative development officers. It is natural, that only an important manufacturer can afford such an information service. Those manufacturers who develop new designs without information on the state of world technique and protected rights are open to the danger that they will violate these rights with all serious consequences. Ignorance is an excuse of no one as well as the statement that they acted in good faith.

The mentioned facts mean that the creative development workers are limited in their activity to a large extent by existing protected rights of others. Creation of new designs because thus more difficult all the time and again only the important manufacturers can hold the field in this situation.

Another of the manufacturers protected rights is the trade mark, the primary function of which is the protection of the consumer. The consumer, who gave preference to products of

a certain manufacturer, requires then, when buying, again products bearing the manufacturers trade mark. For the consumer, the trade mark is a guarantee that the products will be of the quality and properties because of which he preferred them.

With the trade mark is connected even an increased responsibility of the manufacturer. The trade mark is an obligation that the products bearing it will really have those properties, because of which the consumer requires them, and these properties naturally must be permanent.

The trade mark is a testimony of the manufacturer and his employees. It serves to support the effort of all participating in development and production to keep the trade mark's good name in wide consumer circles. It is generally known that a well established trade mark has its monetary value, which is being increased by further use, and it represents values created sometimes by the work of the whole generations. Finally the trade mark serves also for the products' advertising and for protection against less valuable copies.

By all this the trade mark serves also the protection of the direct creative activity, the result of which is materialized in the products. Here again it is true, similarly as with protected rights which were discussed above, that only an important manufacturer can ensure a permanent value of his trade mark through maintaining his products on the necessary technical level and through having them produced in good quality. This fact directly binds creative technical personnel concerned with the development of new products and it influences not to a small extent their activity.

8. Importance of motorcycles in the economy of developing countries.

In developing countries the motorcycle has the function

of transportation means. Because of its low price it can be afforded by wider population strata to which it is open at the same time as a means of increasing their standard of living.

With improving living standard in the developing countries the number of inhabitants with a purchasing power enabling them to buy a motorcycle is steadily growing. Thus while lawfully, the living standard is being increased for the top population strata whom the motorcycle enables a fast and cheap transport to work, shopping, recreation etc. At the same time the motorcycle contributes to technical education of users, its maintenance helps to achieve technical skill and thus to increase qualification for jobs and ability of users to do more qualified work.

For the economy of development countries the increased number of motorcycles brings about acceleration of transport, shortening of lost time of workers due to non-motorized transport, increase of services connected (maintenance, servicing, petrol, tyres) and, connected with this, increasing qualification of these services personnel to the benefit of the whole economy. As a first degree of motorization that can be afforded by wider strata the motorcycle brings earning to service operators and increases sources of indirect taxes benefitting the state.

All the mentioned facts, therefore, clearly indicate that the developing countries should support in all possible ways the increase of the number of motorcycles in service.

9. Importance of introduction of motorcycles assembly for the economy of developing countries.

The motorcycle is a very suitable subject for beginning industrialization of developing countries. Because of its simplicity the motorcycle assembly of imported parts does not require an especially high civilized quali-

fication. It could be even said that it is a very suitable teaching aid for the basic training of workers, whom it enables to obtain the first degree of mechanical qualification. Another advantage of assembly are comparatively low costs of the necessary equipment. Thus, it is possible, with limited means, to carry out the assembly of motorcycles out of imported components which on one hand enables training of semi-skilled workers and later even of skilled workers, provides opportunity of work for the population and serves to increase the number of motorcycles in the country to the benefit of national economy.

This first step to industrialization is then followed by another one in the form of production of some more simple components on an inexpensive equipment and so gradually till the production of components more exacting as far as their production is concerned on a more complex and expensive equipment.

The approach of motorcycles assembly out of imported components was adopted by a whole number of developing countries as, for example, India, Turkey, the United Arab Republic and other. Some of them succeeded, through development of assembly, in gradually limiting and even finally abolishing the import of complete motorcycles, as assembly plants on their territory can satisfy the demand on their home market.

It is not, of course, advantageous to introduce production of more complicated, productionally more exacting components, which will be manufactured by a developed production plant always in considerably higher quality and more cheaply than by the assembly plant which with respect to lack of highly skilled workers barely can achieve the necessary quality and cannot achieve, with respect to quantities produced, the low prices which in the production of complex components can be achieved only through mechanization, standardization and unification on a wide scope.

In countries, where in the course of time the necessary conditions will be created, production of a prevailing number of motorcycle components under a strong support of providers of technical assistance can take place. Achievement of such a degree, however, requires considerable time, necessary on one hand for training of labour, on the other hand for obtaining of means for purchase of the respective production equipment.

From the mentioned it follows that the introduction of assembly is in all respects advantageous for economic development, industrialization and living standard growth of developing countries .

10. Conclusion

Considerations and information stated in the paper " Motorcycle from the aspect of present state and that of the perspective" can be summed up into these conclusions:

The field of motorcycles, as proved by statistical surveys, shows a rising tendency as far as the total world production as well as world sales are concerned. Naturally, concentration of production with strong manufacturers takes place.

The probable perspective production trend in this field appears to be, for more years, favourable ; rising. Vehicles of the motorcycle branch are a support in the present development of motorization, they serve on one hand as transportation means, on the other hand for sport.

The mentioned data and explanations show that the necessary research and development and the following vehicles of the motorcycle field production itself is not a simple matter. It requires considerable experience, experience and scientific approach due to ever increasing technical requirements placed on these vehicles. These pre - conditions are found for example at the known foremost motorcycle manufacturers.

For the economy of developing countries vehicles of the motorcycle field might be of great importance as means of transporation, with prices that wider population atrata can afford, and as a means of technical training of their users and to improve the standard of living.

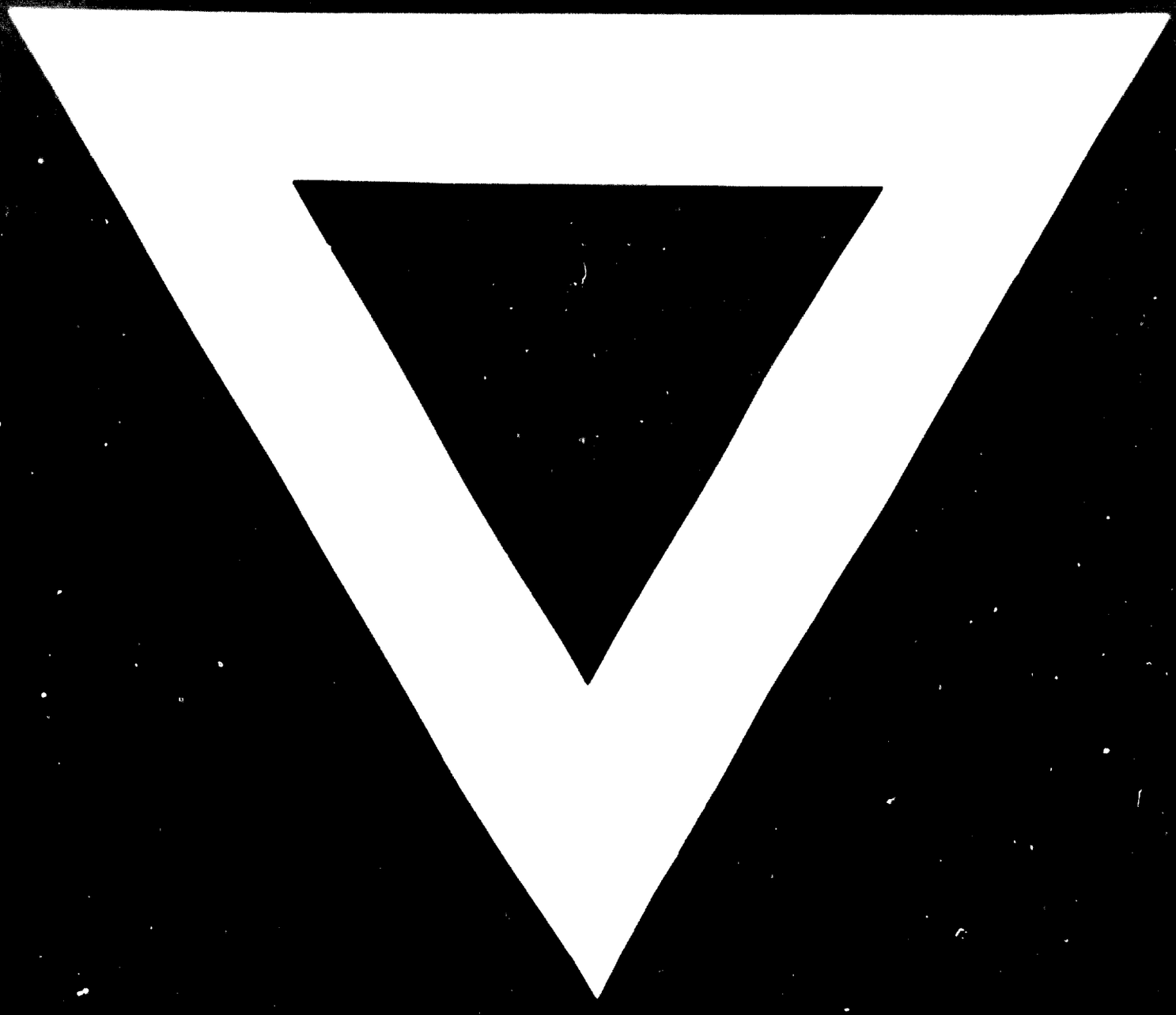
For these countries it is suitable to start production of motorcycles in stages, where the first step of industrialization is the assembly of imported components and pos - sible production of more simple parts, a later higher degree then licensed production.

11. Titles of tables

1. Total production of vehicles of the motorcycle field in the world
2. Production of vehicles of the motorcycle field in the world (divided according to types)
3. World production of different vehicles types of the motorcycle field - year 1966
4. Comparing of the world's population and the number of motor vehicles
5. Comparing of the total annual production, numbers and density of motorcycles in the world
6. Division of the total motorcycle production in the world into proportions according to determination - estimate for the year 1980
7. Prospect of production growth and the state of vehicles of the motorcycle field to 1980

Sources

The statistical and numerical data mentioned were taken from accessible statistical annuals and from technical press.



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