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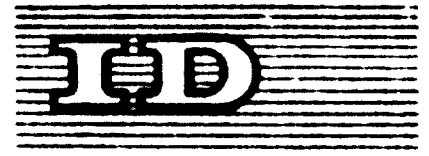
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Central Maintenance and Repair Shops

by

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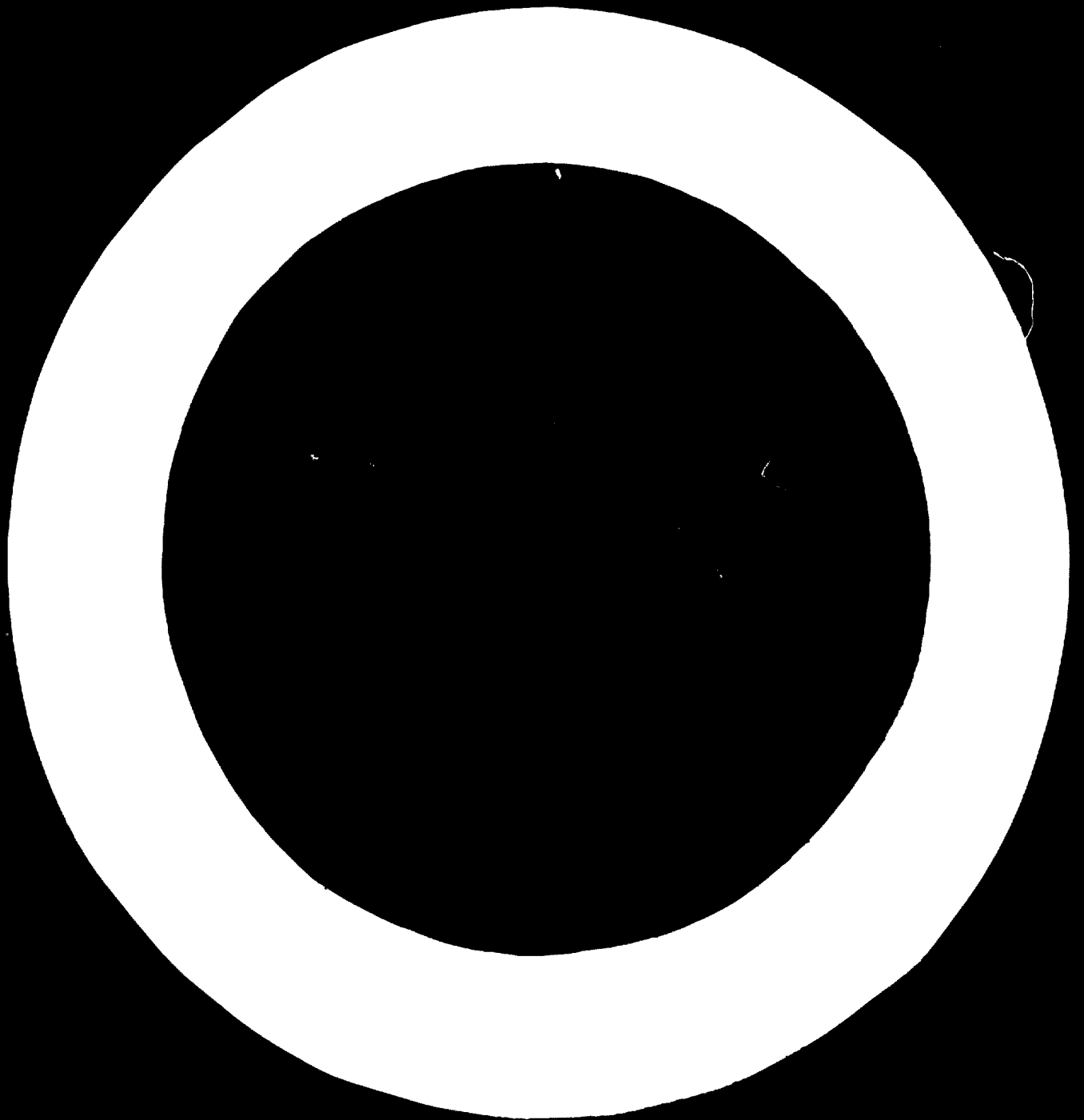
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Contrary to industrial enterprises in typically industrial countries, industrial enterprises in developing countries find it difficult to maintain, service and repair their mechanical equipment and car fleets. Industrial enterprises in industrial countries have the advantage of being located in relative proximity to the manufacturers of their mechanical equipment. Furthermore, the problem of covering long distances is of minor importance once the road network is well developed. Moreover, postal and railway systems are so highly developed in industrial countries that it is possible to deliver spare parts and parts subject to wear within a very short period. Orders placed by telephone or teleprinter reach the producer within minutes, thus enabling a well-organized enterprise to despatch the ordered articles the same day.

Of course, a complete and well-kept stock of spare parts must be considered a first requirement. This, in turn, presupposes knowledge of the weak points of machinery or equipment. Naturally an entrepreneur will never carry stocks of those parts which are known to be indestructible, but he will be farsighted enough to provide for an adequate stock of those parts, which by experience are subject to extensive wear and tear or break easily if handled carelessly.

In buying machines and other mechanical equipment, the purchaser sees to it that the respective spare parts are delivered in sufficient quantity. These are mainly transmission belts, seals, etc. The spare parts are clearly listed in an illustrated catalogue, thus enabling the machine operator to quickly find the order number of the damaged part and place his order by telephone, teleprinter, or any other means of communication.

The consumer may also consult the well-organized customer service which is taken for granted nowadays. Well-trained personnel, equipped with special customer service vehicles, with tools and spare parts, do not only help in case of need but also improve the reputation of their firm by providing a fast service.

Repair work may be put in hand at short notice and the amount of time machines stand idle reduced to a minimum when there are only short distances between producer and consumer, and it is possible to place orders in a relatively short period of time, when there is a well-developed road system and a smoothly functioning transport system, when the stores are well equipped with spare parts that are clearly listed in illustrated catalogues, and when the customer service is staffed by experienced personnel. Delays in delivery thus become negligible.

In developing countries the situation is completely different as distances between the manufacturer and the purchaser of the machines are very great. In the country itself there are no facilities for the production of machines, they must therefore be supplied from industrial countries. The first problem will be finding the cause of breakdown because of the lack of trained personnel. Written material such as operating instructions, data on mechanical equipment and spare part catalogues does not always appear in the language of the country concerned, so that interpreters must be consulted, which may easily lead to misunderstandings. The transmission of orders to the producer depends on the means of communication available.

Enquiries—which are quickly dealt with in industrialized countries—may take weeks in developing countries. Transportation by sea or air contributes considerably to the increased repair costs. Customer services which are readily available in industrialized countries are still lacking in the majority of developing countries.

All these problems call for a solution having the effect of making the consumer as far as possible independent of the manufacturer as far as spare parts and repairs are concerned. The way in which this could be achieved is explained below.

Therefore the problem is how to manufacture and repair the machine parts needed by small businesses when there is a lack of skilled workers and necessary equipment.

For this reason it is important that the enterprises in the developing countries be divided into the following groups:

- I. Enterprises which are not confronted with the problem, i.e., those with their own skilled personnel and spare part depots or spare part production. These include power plants, large-scale industrial enterprises such as motor works, etc., broadcasting and television companies, mineral oil drilling plants, mines, etc.
- II. Enterprises which either hold limited stocks of spare parts or are able to obtain them, but which lack the technical personnel required. These include hospitals, food processing plants such as sugar factories, mills, bread and bakery products industries, slaughterhouses, canneries, cigarette plants, breweries.
- III. Enterprises which entirely lack technical personnel as well as the facilities for manufacturing and storing spare parts. These include transport organizations carrying passengers and freight on land and water, authorities with community-owned vehicles (street cleaning, refuse disposal), small textile processing enterprises, sawmills and woodworking enterprises, road construction firms with road building machinery, producers of building materials and associated machines, enterprises with limited power production facilities.

In this context the enterprises mentioned under III are of particular interest, i.e., enterprises which are short of technical personnel and spare parts.

Special problems have arisen in cases where the introduction of machinery is part of the development aid contributions made by various industrialized countries. So it may occur that an enterprise will possess many different machines, all of which differ considerably from one another as to servicing and maintenance requirements. Hydraulic machines need a specific type of oil recommended by the manufacturer because of their oil seals. In cases where these machines are supplied by different firms or countries even, the first difficulty consists in selecting the correct oil, not to mention the problem of spare parts.

If it is necessary to contact every manufacturer when a machine breaks down in order to obtain spare parts, an organization is required for purposes of coordination, and it can often happen that a machine has gone out of production and the spare parts required are no longer available.

In order to remedy this situation a way must be found to repair machinery that has broken down and even produce the required spare parts.

One way would be the establishment of central workshops which once equipped with skilled personnel and adequate machinery would be able to provide help where needed.

The term "central repair shop" means an enterprise which is centrally located and can be reached from every place in about the same time. Centrally located does not mean that the exact centre is determined with dividers. The available network of waterways and roads determines the location of the central repair shop. In addition, the density of industrial enterprises and the proximity of an airport must be taken into consideration.

Another important factor is the availability of a mains electricity supply and a telephone network. Generating

equipment belonging to the repair shop can temporarily replace the mains electricity supply. For long-term solutions a mains electricity supply should be available.

Persons who visited and studied the developing countries confirmed that a skilled worker can find a job in every city. Thanks to his wage he can afford a flat in the town, which he would hesitate to exchange for living quarters in an unsettled area. When selecting the location of the central repair shop attention must also be paid to the transport facilities to the next housing area or town.

The supply of water must obviously be taken into consideration. Water purification plants can be used in cases where there is merely a shortage of drinking water.

It will be difficult to immediately find the right location. On the one hand, all mentioned requirements should be fulfilled but on the other hand the customer, namely, the enterprises for which the repair shops are intended, should be able to contact the repair shop quickly.

It would be wrong to begin immediately with the construction of sheds, workshop and living quarters without previous experience. At first the volume of work should be determined taking into consideration the distances involved. The construction of dismantlable living quarters is therefore recommended. The systematic construction of sheds, office buildings, and living quarters should not commence before a site has been finally decided upon.

The tasks of a central repair shop can be divided into three groups:

- a) repair of machinery and equipment belonging to enterprises not having skilled personnel, and the production of spare parts;
- b) training of apprentices, skilled workers, masters, training of unskilled workers, organization of training courses and demonstration of machinery;

- c) carrying out work as subcontractor; perhaps a consumer goods production line.

Due to the difficulties mentioned with regard to personnel and materials it is not possible for industrial enterprises in developing countries to maintain their own mechanical engineering shops. While the central repair shop can train its skilled personnel to be turners, welders, and milling machine workers, for example, these workers would not be employed to full capacity in small industrial enterprises. Therefore the businessman has to rely upon the central repair shop.

The relationship between the businessman and the central repair shop can be seen as follows: One of a company's machines breaks down, and the staff are not sure what is wrong with it. They are uncertain whether the machine can be repaired on the spot by a skilled worker, and so the central repair shop is informed and asked for expert advice.

At this point the use of the mobile workshop is recommended, which has proved useful all over the world, and which is also known in developing countries. Mechanical troubles to motor vehicles, agricultural machinery, road construction machines and equipment can be quickly found and, in most cases, be expertly repaired.

A mobile workshop is a workshop mounted on a normal or crawler-type vehicle, equipped with the required tools; the mobile repair shop must have easy access to the object to be repaired. The size of the mobile repair shop depends on the jobs to be done. For maintenance and lubricating jobs a station wagon suffices. If large-scale repairs have to be carried out, a large number of tools, machines and test instruments must be available. As the vehicle carrying the workshop does not only serve to transport the mentioned equipment, but should also provide working space, this space will not be sufficient for a large number of craftsmen. For this reason craftsmen should

be employed who have been trained in as many skills as possible. This also applies to the driver.

If the roads permit the use of a mobile workshop, it will be driven to the businessman who has reported a mechanical fault. The skilled worker decides whether he can effect the repair with the equipment he has at his disposal, i.e., turning, drilling, grinding, and welding apparatus.

Straightforward repair work and the production of simple replacement parts can be carried out on the spot. Machines and equipment are occupied for short periods only and are soon available for other work. If, when a piece of machinery is dismantled, the shop proves inadequately equipped to deal with it because, for example, urgently required milling operations cannot be carried out, the damaged part is removed and taken back to the central repair shop to be repaired or remade. If the whole machine is found in need of a general overhaul, it must be sent to the central repair shop. For this purpose a fleet of transport vehicles belonging to the central repair shops must be available on request. An initial period of operation must elapse before it is possible to determine how many of these vehicles are required, and what their capacity should be. It is not possible to state exactly what size of vehicles are required, because this will be revealed only by experience.

The main function of the central repair shops is therefore the repair of machinery and equipment belonging to small businessmen, where this work cannot be undertaken by the mobile repair shops, the production of replacement parts such as gear wheels and all other parts requiring turning and milling operations which can be carried out with the mechanical equipment available.

The second important function of the central repair shops is to train skilled workers. A well-equipped central repair shop can easily prepare 20 to 30 apprentices per year

for the skilled worker's examination. That means that with a 3 1/2 to 4 year apprenticeship the shop will always have 80 to 120 apprentices in training. A well-equipped workshop is necessary for the first two years training of mechanics, precision mechanics and toolmakers, blacksmiths, motor mechanics, electricians, and perhaps also joiners. The number of apprentices is determined by the size of the shop, its mechanical equipment, and, at least, the number of skilled workers in a position to pass on their knowledge and skill to another person. The future technological development of a country is dependent on the quality of training given to apprentices, and it is essential that those who set the standards appreciate this fact.

Training shops specializing in the training of skilled workers are left out of account. What is being considered here are apprentice shops which have been established with the development aid of individual countries, but which are independent of central repair shops. The skilled workers produced by these apprentice shops could later develop into the new generation of technicians and engineers.

Advanced training courses for skilled workers leading to a master's certificate must be held in addition to apprentice training courses. Short training courses for unskilled workers must be held in conjunction with apprentice training courses in order to create a labour force capable of carrying out work that does not require a craftsman's skill. This will considerably reduce the cost of repair work.

The further training of workers for specialized work must also be considered. The training of workers in special skills such as autogenous and electric welders, shielded arc welders, etc., is in the interest of the central repair shops, because this will later help small enterprises to have repair work carried out locally. This will then reduce the central repair shop's work load.

The planning of a central repair shop must be based on the expected volume of repair work. Personnel and mechanical equipment must be available in order to ensure that work may be smoothly carried out. If the inflow of work is not continuously in correct proportion to the size of the shop, a compromise is necessary, i.e., work of a different type is undertaken. Setting up a production line for the manufacture of consumer goods would be a paying proposition. Household utensils, for example, are products for which there would be sufficient domestic demand. They could be produced on the presses available, and this would fill the gaps between repair work. Care must be taken, however, not to allow repair work on vital machinery and equipment to suffer as a result of the consumer goods production line. Repair work and the production of replacement parts must always be given priority.

The location and activities of the central repair shop have now been dealt with, and it remains to describe what type of machinery, tools, and equipment are required.

It may be stated that the essentials are as follows:

A sufficient number of machine tools of different sizes and working capacities, and of the most straightforward design and construction, possessing all the usual fittings, together with special attachments, and a complete set of tools.

Special machines which remain unused most of the time, and therefore represent a bad investment, and also automatic and semi-automatic machines should be avoided and preference be given to manually operated machinery. The work sent to the central repair shops is of the one-off variety, and any production line must make use of simple machinery.

This type of central repair shop may be equipped as follows with:

- a) Machine Tools: Lathes of various types, bench and column-type drilling machines,

- milling machines of various sizes, planing machines of various sizes, grinding machines of various types, e.g., tool grinding machines, cylindrical grinding machines, surface grinding machines, double wheel stand grinders, sawing machines
- b) **welding shop** equipped with electric and autogenous welding and cutting equipment, spot welding equipment
- c) **smithy** with blacksmith's forge, anvil and swage blocks
- d) **tinsmith's shop** with tin shears, universal machine, folding press, embossment and bending machine, flanging and wiring machine, hydraulic presses
- e) **joinery** with planing machines, band saw, circular saw, carpenter's benches
- f) **toolroom** with various, hand-operated electric machine tools and complete tool sets
- g) **apprentice workshop** with workbenches and vises
- h) **classroom** with corresponding equipment.

Should the planned central repair shop be extended to include vehicle repairs the following shops and equipment are needed:

- a) **engine repair shop** with equipment required for repair of valves, cylinders and pistons

- b) shop for the repair of electric units test stand for dynamo and starter
- c) battery-charging station with battery-charging equipment
- d) chassis repair shop with pits, lifting stages, lubricating bays, brake testers, tyre repair equipment, balancing machines
- e) car washing plant
- f) paint-spraying plant.

The above-mentioned list of equipment does not claim to be complete. It is intended to show what equipment a good repair shop should have if it is to carry out a wide range of repair work and cannot exactly anticipate with what tasks it will be confronted.

When planning the repair shop it must be ensured that sufficient materials are available. The same applies to tools which are subject to wear. Special emphasis must be placed on the supply of technical gases.

Due to the large number of machines and equipment from various countries, tools of both the metric and the British systems must be available. This applies above all to drills, screw taps, reamers, and spanners.

Another important point should not be overlooked: safety measures should be taken against fire, theft and accident; sanitary installations must be provided.

Office space must be provided for the technical management, administration and personnel office. This must be taken into consideration when planning such an enterprise. In addition, meeting rooms, recreation rooms and canteens are needed.

So far only the advantages of establishing central repair shops have been pointed out. There is no doubt that in most developing countries there is a real demand for such workshops. Discussions with persons working in various authorities who have had the opportunity of studying the situation in developing countries confirmed that much has been done in the field of training, especially the training of apprentices, but that there is no institution where repairs, training and perhaps the production of consumer goods are carried out under the same roof; the establishment of such an institution would be commendable.

Apart from the advantages, mention must be made of the difficulties which may arise. The list of these points does not claim to be complete. Certainly a number of other objections will be raised against the establishment of central repair shops, partly in those countries providing development aid. Nevertheless the fact remains that, due to the further development of industry and small handicraft enterprises, the times of primitive production without machinery have come to an end.

Some points, however, must be taken into consideration.

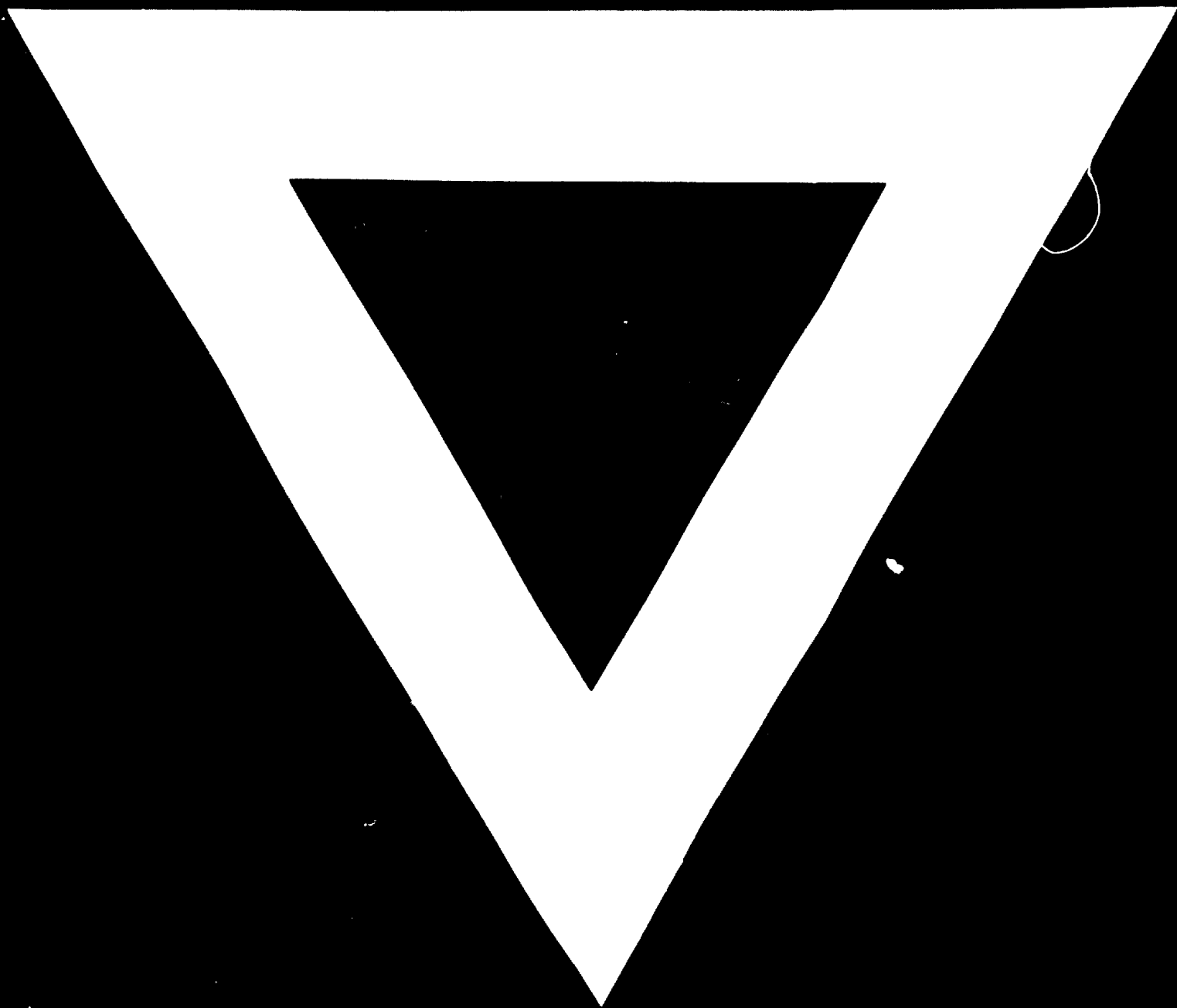
- 1) In many regions where businessmen are already operating relatively simple machinery, it was possible to find workers who were prepared to carry out repairs on this machinery. The repairs, which can be made in a central repair shop in a few hours, are carried out by these persons with primitive means in many days of laborious work. These persons lose their jobs when a central repair shop is established.
- 2) There is the danger that in a modern enterprise like a central repair shop an unnecessarily large administrative organization develops out of all proportion to the size and profitability of the enterprise. As a consequence the costs for the jobs to be done would be too high. The customer will carefully consider whether

the repairs would not be cheaper when carried out in the old traditional way with hammer and chisel, even if he has to wait longer.

- 3) It has not been decided whether the central repair shop should be a governmental or private enterprise. Who should provide the funds and administrate the enterprise? Are there funds available from development aid or does the government have to provide the money? Should such an enterprise be run privately? If so, how can prices be controlled.

When all the advantages and disadvantages have been taken into consideration, the establishment of central repair shops for the maintenance and repair of all types of machines and equipment cannot but be recommended. Repair shops which are well laid out, equipped with efficient machinery and skilled workers contribute to a country's progress towards industrialization.





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