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30 June 1968

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

Karlovy Vary, CSSR, 14 October - 1 November 1968

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PROBLEMS RELATED TO THE PRODUCTION AND SUPPLY OF AUTOMOTIVE COMPONENTS 1/

by

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PROBLEMS RELATED TO THE PRODUCTION AND SUPPLY OF AUTOMOTIVE EQUIPMENT COMPONENTS[1]

by

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SUMMARY

1. In developing countries the needs for the supply of automotive spare parts differ from those in developed countries. The reasons for these differences are many, e.g. quantity and type of vehicles, quality of roads, climate, and technical competence of the drivers and of the service and repair personnel.

2. Developing countries should work out their own system of classification of automotive components according to their needs of replacement or according to the feasibility of local production.

3. The conditions for the establishment of factories for local production of automotive components are reviewed, e.g. market, sites for erection of the factories, banking facilities, government policies, and inducements.

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* This is a summary of a paper issued under the same title as ID/WG 13/6.

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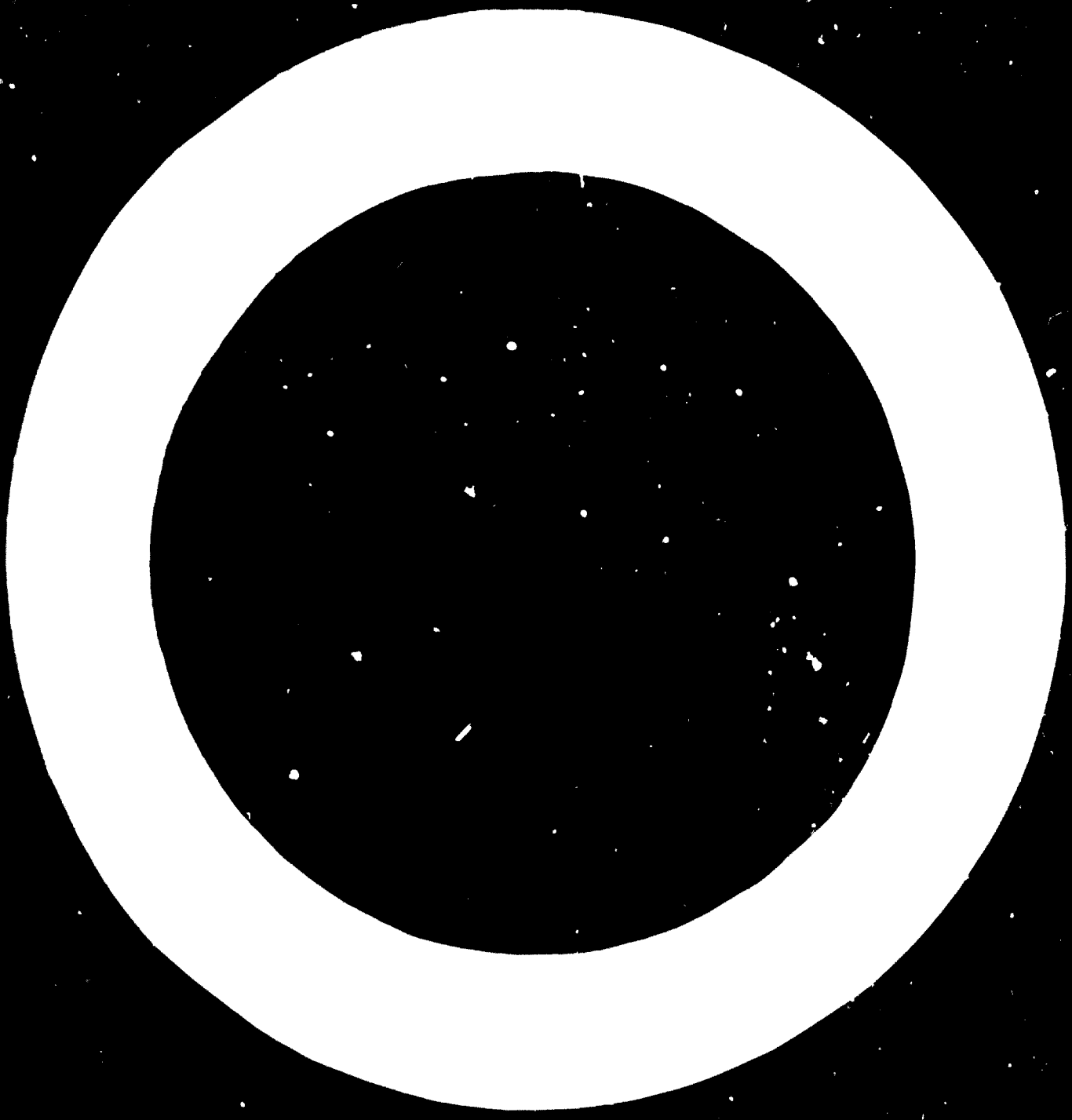

4. Large-scale production in developed countries justifies investments in expensive big-scale production equipment and in automated equipment. The installation of such specialized equipment in developing countries, where smaller lots of wider variety prevail, is not considered advisable, as costs for the setting up and amortization would render these investments unprofitable. Other factors influencing the selection of production methods in developing countries include the availability of raw material and skilled workers, and the possibility of obtaining second-hand machinery under advantageous conditions from a co-operating company.

5. The paper discusses the manufacturing methods used for the production of some automotive parts under both large- and small-scale conditions.

6. Also presented are the principles involved in integrated, long-range plans necessary for the successful implementation of an automotive industry in a developing country and illustrating the basic problems one may expect to encounter in developing an automotive parts industry.

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Introduction

1. No automotive vehicle manufacturer builds his product entirely out of raw materials, engineering and producing every part of the vehicle in his own plant. A numerous quantity of components comes from outside suppliers. While the content of purchased parts in a finished vehicle will vary from manufacturer to manufacturer, from vehicle type to vehicle type, and from country to country, it is estimated that most mass produced, standard type passenger cars contain on the average of 30 to 50 per cent purchased components. In trucks, particularly heavy trucks, this ratio may be as high as 70 per cent.

2. The manufacturers of automobile components, are an essential and important branch of the automotive industry. They have distinct problems, particularly in developing countries where the maintenance of an existing fleet of motor vehicles, as well as the introduction of local automotive production, calls for careful planning and the solution of technical, financial, political and human relations problems. This paper attempts to deal with these considerations and to suggest an approach for satisfying the demand for automotive equipment components by providing an adequate supply and production of needed parts. Such an approach is derived from actual experience in certain developing countries and by analysing the reasons for successes, as well as failures, that have occurred.

I. CLASSIFICATION OF COMPONENTS IN WORLD TRADE

3. The normal classification of parts is divided by their use and application on a specific unit of the vehicle. Thus we arrive at nine main categories of components:

(a) Engine parts: pistons, piston pins, piston rings, valves, valve guides, valve lifters, valve springs, fuel pumps, oil pumps, water pumps, carburettors, air and oil filters, bearings, radiators, thermostats etc. and electrical engine components (such as starters, generators or alternators, spark plugs, distributors, condensers);

(b) Power train components: transmissions, clutches, drive shafts, differentials, universal joints, rear axles, wheels and tires;

(c) Steering components: steering wheels and columns, steering gears, tie rods, ball joints;

(d) Suspension and brake system components: king bolts, ball joint suspensions, leaf springs, coil springs, shock absorbers, drum and disc brakes, brake cylinders, fittings, hoses;

(e) Instruments and lighting accessories: dashboard instruments, head lamps, tail lights, electric batteries, wiring, windshield wipers, rear view mirrors;

(f) Chassis parts: gas tanks, exhaust pipes, mufflers, bumpers;

(g) Comfort devices and accessories: heaters, air conditioning systems, fans, radios, cigarette lighters, ash trays;

(h) Body trim and hardware: hinges, handles, locks, window operators;

(i) Miscellaneous tools: jacks, grease guns, tire wrenches, screw drivers and other hand tools.

4. This normal classification does not take into considerations the problems encountered in world trade, particularly problems affecting developing countries and their demand for automotive components. Developing countries originally are more interested in classifying automotive components according to the demand for the replacements of parts wearing out frequently. Not having manufacturing sources of their own at the start, they have to satisfy this demand by importing such parts either from the service departments of the vehicle manufacturers or from the specialized foreign parts manufacturers. (If the parts manufacturer happens to be a supplier to the vehicle manufacturer, identical parts may be available from either one.)

5. The special requirements of a region will be dictated by road conditions, climate, and not the least by the human element: the ability of the driver of the vehicle, as well as the competence of the man who services the vehicle. A developing country concerned with the problem of maintaining its vehicle fleet should work out its own priorities for an adequate supply of needed replacement parts and components according to criteria indicated above.

6. As the number of vehicles in a country increases, a point may be reached when it becomes feasible to develop a national industry for the manufacture of some of the replacement parts. While such a development will be discussed in its various aspects later in this paper, it should be mentioned here that a developing country may well start classifying automotive components according to the feasibility of producing them locally.

7. On the top of the list will be parts made from common materials by simple manufacturing processes not requiring elaborate manufacturing equipment or tooling: for instance, mufflers, filters, ignition cables. The next category may include relatively simple machined components such as water pumps, brake drums, bushings, various springs. More technical and financial help may be

required for the third category of parts calling for higher skills, more sophisticated materials and more elaborate equipment, including forging and foundry installations to produce valves and valve train components, pistons and piston rings, steering components, complete brakes, spark plugs, distributors, carburettors, starting motors and generators. This classification furnishes a key to the progress by which a developing country satisfies the demand for automotive components, and a key to the stages through which a developing country advances to provide a reasonable supply of automotive equipment components.

II. FACTORS CONTROLLING THE DEMAND FOR AUTOMOTIVE COMPONENTS

8. First, let us consider a developing country with no automotive industry of its own, where all vehicles are imported. With no domestic sources available, all components needed for replacement or repair have to be imported.

9. With some exceptions, a developing country's vehicle fleet consists of a higher proportion of trucks and buses than that of a developed country. A few countries selected at random illustrate this condition in table 1, which lists the total car, truck and bus registrations in 1966 and their individual proportion of the total.

10. It will be noted that developed countries (with the exception of Japan) have a high proportion of passenger cars, whereas trucks and buses comprise only 9 to 18 per cent of the total registration. Japan, which has developed its automotive industry only recently, is an exception and probably will remain a "maverick" because of its geographical make-up and its extremely dense population. Developing countries, particularly those which do not possess a network of railroads, have a greater need for trucks and buses. The countries listed in the lower part of table 1 serve as an example where trucks and buses represent 44 to 56 per cent of all registered vehicles.

11. Thus, the make-up of the vehicle fleet has to be recognized as one important factor controlling the demand for automotive components. Developing countries need components for the maintenance of their trucks and buses in a greater proportion than the richer countries with their larger passenger car complement.

Table 1

1966 vehicle registration in selected countries

Country	Number of cars, trucks and buses	Percentage of total		
		cars	trucks	buses
Developed				
France	10,772,500	82.0	17.5	.5
Italy	6,155,500	89.0	10.5	.5
United Kingdom	10,882,700	84.0	15.0	1.0
U S A	90,486,000	83.5	16.2	.3
Germany (Fed.Rep.)	10,763,700	91.0	8.7	.3
Japan	6,823,700	32.0	66.5	1.5
Intermediate				
Australia	3,788,000	76.5	23.0	.5
Brazil	1,902,100	55.5	40.0	4.5
Developing				
Greece	172,900	56.5	37.5	6.0
India	715,500	51.7	37.1	11.2
Turkey	197,000	43.5	44.5	12.0
Chile	193,000	48.0	45.5	6.5

Source: 1966 World Automotive Market Survey, McGraw-Hill, New York.

12. As mentioned previously, the condition of the roads and the climate of the country will also be factors controlling the demand for components. For instance, poor roads and dust will increase the demand for shock absorbers, tie rod ends, springs, brake linings, pistons and piston rings, filters, wheel bearings, to cite just a few chassis and engine parts. Hot and humid tropical climates will increase the replacement demand for ignition wires and miscellaneous rubber parts. A very cold climate may cause an unusual increase in the wear and high replacement of batteries and starters.

13. Possibly the most important factor affecting the demand for replacement parts is the technical competence of the people who drive the vehicles and those who service them. When a country begins to motorize its economy, it takes a few years to educate and train the people in the use and maintenance of automotive equipment. It is inevitable that during that period inexperience and prejudice will exact a heavy toll on many parts and components, which under proper care would last much longer. There are many inexperienced or careless drivers who will wear out clutches, transmissions, brakes, engine valves at an alarming rate. Poorly equipped service shops or poorly trained mechanics will accelerate the need for replacement of ignition system components, valve lifters, gaskets, tires and so forth.

14. Two classic examples (from personal experience in a then developing country) will illustrate the importance of the human factor. Both of these examples show what happened when there was a lack of understanding of an engine cooling system, and how inexperience (or ignorance) shortened the normal life of the components.

15. Our party was riding in a newly imported American car. The owner and driver of the car was a prominent businessman of this tropical country. Part of the route led over a spectacular mountain road involving a steady and steep climb of 3,000 feet in less than ten miles. We stopped at the last gas station at the foot of the mountain and our driver had the radiator checked and filled; he also personally made sure that the radiator cap be left loose because, he explained, the water will get hot and one must let the steam escape. My pleading to put the cap on tight for the pressurized cooling system was to no avail and we started up. "Nobody in this country", I was told, "would be foolish enough to drive up this mountain with a tightly screwed on radiator cap." There are several turnouts on this road and they were packed with steaming cars; hoods up, while the drivers were waiting for the boiling to subside to refill the radiator. As we drove on,

the temperature indicator approached the red warning zone, but our driver kept going until just at the summit the overheated engine began to stall. Apparently almost all the coolant had boiled away, and we had to haul bucket after bucket of water from a well some distance away. This time I disregarded the driver's protest, put the radiator cap on tight and lectured to my friend that keeping the system under pressure raised the boiling point and prevented the evaporation and loss of the coolant. I have learned later that my advice was followed, and the mountain stretch has been negotiated by my friend frequently since then without any radiator trouble.

16. The local engineer of a truck manufacturer, with whom I talked about this incident, confirmed that the practice of loosening the radiator cap before a long climb was prevalent in the region and was the cause of premature damage to vital engine parts. Then he told me about an other typical local prejudice which had an adverse effect on the life of truck engine components. Apparently, the local truck drivers assumed that the thermostat regulating the coolant temperature was not only unnecessary in the warm climate of this tropical country but, in fact, harmful. Most drivers took it upon themselves to remove the thermostat from their engine cooling system. This resulted not only in a long engine warming-up period, but too often the engine never reached a proper operating temperature. The obvious effect was an unusually rapid wear on engine components. It took intensive research by the truck manufacturer's engineers to discover the reason why their engines lasted barely half as long as they should. A massive educational campaign finally corrected this condition.

17. These two examples show how the human element may have a significant effect on the life of and consequently on the demand for automotive components. The producers of automotive vehicles could recognize the lack of technical understanding initially in a developing country and prevent some of these occurrences by writing special editions of instruction books tailored to the peculiar needs of a country or region.

III. SUPPLY OF AUTOMOTIVE COMPONENTS

18. With the arrival of the first vehicles in a developing country, it is the automobile manufacturer who assumes the responsibility for importing and supplying parts and components needed for maintenance. When several makes and models of vehicles come into the country, a second source of replacement parts is likely to develop: the parts distributor. He is usually an aggressive native businessman who sees the opportunity to establish himself in a growing and promising field geared to the economic growth of his country. He secures franchises from well-known parts and component manufacturers abroad. From them he receives not only brand name merchandise but also technical help and training, and very often some needed capital. The obvious advantage of this franchised distributor derives from his ability to furnish genuine brand name replacement parts to repair and maintenance shops. Thus the repair shops would then have one source from whom to obtain quickly all the components needed to do their work.

19. An ultimate stage of supply is finally reached when the developing country has acquired a substantial vehicle fleet with a corps of trained mechanics, and has the resources to start domestic production of some of the components. The problems associated with the domestic manufacture of automotive parts are described in some detail in the next section.

IV. DOMESTIC MANUFACTURE

20. A developing country strives for industrialization, and one of the first steps toward that goal is often taken by establishing plants for the manufacture of simple automotive equipment components. It is important to understand that this production is not undertaken to furnish lower priced parts than those being imported. Initial costs of such domestically manufactured parts and components may be twice to eight times as high as prices paid for imported articles, and possibly also of poorer quality. This disproportionate apparent "waste" is often criticized by local consumers as well as by exporters and industries from developed countries. It should be remembered however that parts are produced primarily to provide employment and to teach industrial processes to local workers regardless of cost; and, also to avoid importation of these components and thereby save foreign exchange regardless of cost. Industrialization is undertaken regardless of cost for the purpose of raising the standard of living in the country.

21. Technical, as well as financial, assistance is often needed to start manufacturing automotive components. In addition, the government must adopt favourable policies and regulations to render such assistance feasible. The technological division of the United Nations has assisted a number of developing countries in this respect by providing experienced technical personnel to study the needs and capability of a country and to give guidance in starting factories. These engineers and technicians develop over-all plans for a modest industrialization, select the products, organize small factories, specify the equipment and provide the initial training of the management personnel and the working force. With such help a good start is made toward providing domestically produced automotive components.

22. Domestic production of automotive components will increase when certain conditions have been created which will justify the manufacture of parts of a greater variety and complexity, particularly those for which the supply of raw materials is readily available. What are these conditions?

23. First, there has to be a sufficiently large market so that a foreign parts manufacturer could consider it worthwhile to license a local manufacturer, to give technical assistance, to enter into a partnership with a local establishment or even establish a wholly-owned subsidiary. As a rule, a sufficiently large market is created for the production of the more sophisticated automotive components when the number of registered vehicles in the area to be served (it could be one or several countries) has reached about 400,000.

24. A second condition to be met is the availability of factory sites with access to basic utilities - electricity, gas, water, telephone - and reasonable means of transportation. A third condition calls for the existence of adequate banking facilities to handle commercial and foreign exchange transactions, extend credits to buyers and so on. A fourth condition is the assurance to the investor that the government of the developing country will maintain a fiscal policy which will be a reliable base for planning the operation.

25. Particular reference is made to the requirement of the foreign participant - be he a licensor, partner or sole owner - that the laws and regulations provide license and patent protection; that the employment of his technicians and engineers is feasible; that the tax laws and certain regulations are clear and uniformly applied. To attract foreign manufacturers and investors, inducements

may be offered in the form of tax relief for the first few years, easing of custom duties on imported equipment which is not available in the country, regulations permitting remittance abroad of funds earned as compensation for technical assistance services, and a share of profits. A further inducement attracting foreign participation may be favourable regulations for the re-investment of profits, thereby insuring internal growth and accruing benefits to the economy of the country.

26. A country enters the ultimate phase of automotive component production when it proceeds to establish its own vehicle production, progressing from assembly operations to an integrated domestic national manufacture. Starting with the assembling of vehicles from mostly imported parts, the industry begins to replace imported parts by locally produced articles as it gradually approaches the ideal of 100 per cent national content.

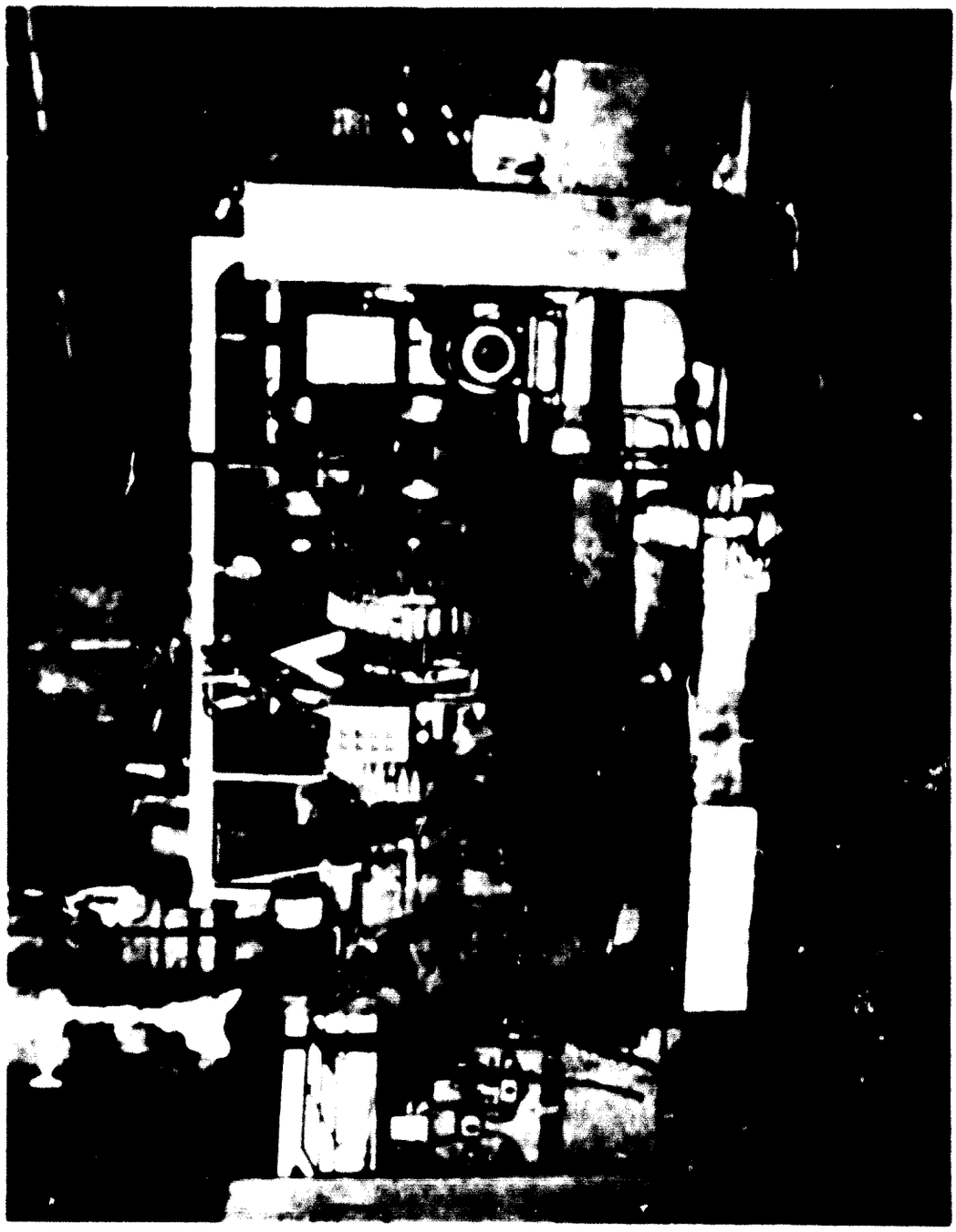
27. Pressure is usually applied to set-up manufacturing plants for every component needed as government authorities prescribe a schedule for increasing local production and the vehicle manufacturers strive to comply. It is a common practice of the vehicle manufacturer to urge the parent component suppliers to either license a domestic concern and give it technical and financial assistance, or to establish a partly or wholly-owned subsidiary for the local production of the needed components. It should be mentioned here that this development presupposes another condition: namely, the existence or creation of auxiliary industries on which the component manufacturer must depend, i.e. machine shops and tool shops, sources for tool steels, cutting tools, grinding wheels, lubricants and coolants, heat treatment and welding supplies, to name a few.

V. MANUFACTURING METHODS

28. Manufacturing methods used in a developed country cannot or should not be copied by the component manufacturer in the developing country. Many factors will influence the selection of the most advantageous manufacturing method and equipment, taking into account economic, technical, financial and manpower considerations. The manufacturer in the developed country often has the advantage of large volume which justifies the use of automated equipment. The relatively high cost of labour and low cost of materials promote labour-saving installations calling for a high investment in tools and equipment.

Photo 1

Special machine for drilling and countersinking cotter hole on ball stud



29. The automotive component manufacturer in a less developed country usually deals with smaller volumes of great variety which require numerous set-ups and tool changes. Installation of complex high production equipment is then not feasible; the direct labour saving would be insignificant when weighed against the increased cost of intricate machines and the amortization of the expensive equipment; nor may the labour be sufficiently skilled to operate and service such a production line. In some cases the unavailability of materials obtainable only in the developed country calls for a change in methods.

30. The company sponsoring the establishment of the manufacturing plant in the developing country may have perfectly good used machine tools not needed at home and well-suited to the production methods planned for the developing country; thus, equipment, may be provided at a considerable saving. The following examples will illustrate the influence of these various factors on the modification of manufacturing methods. The products selected in the examples are automotive steering linkage parts. The high production methods, as practiced in a United States plant are compared with small volume methods of a developing country that was building up its own automotive vehicle assembly and production and wanted to replace some heretofore imported components with domestically produced ones. These actual cases show how production methods were adapted to the capability of a developing component industry.

31. The first example deals with a familiar part - a ball stud - which provides the flexible joints for the steering linkage. This is a heat-treated, precision product made to close tolerances and to exacting finish specifications. The high production method employed by a United States plant starts with heading on a progressive cold header, the stock being fed to it from a coil through a wire draw straightener. The stud is cold-formed, completely finished, except for the cotter hole and the thread, at a rate of approximately 2,300 pieces per hour. Next, the cotter hole is drilled and countersunk on a special machine (figure 1), the studs being fed automatically into the drilling machine from a hopper through a feeding device shown in the illustration, the production rate being again about 2,300 pieces per hour. Finally, figure 2 shows the rolling of the thread on a high production roll threader, again automatically fed and giving an output of approximately 6,600 pieces per hour. A heat treat operation, not illustrated, completes the production process.

Figure 2

High production roll threader for ball studs

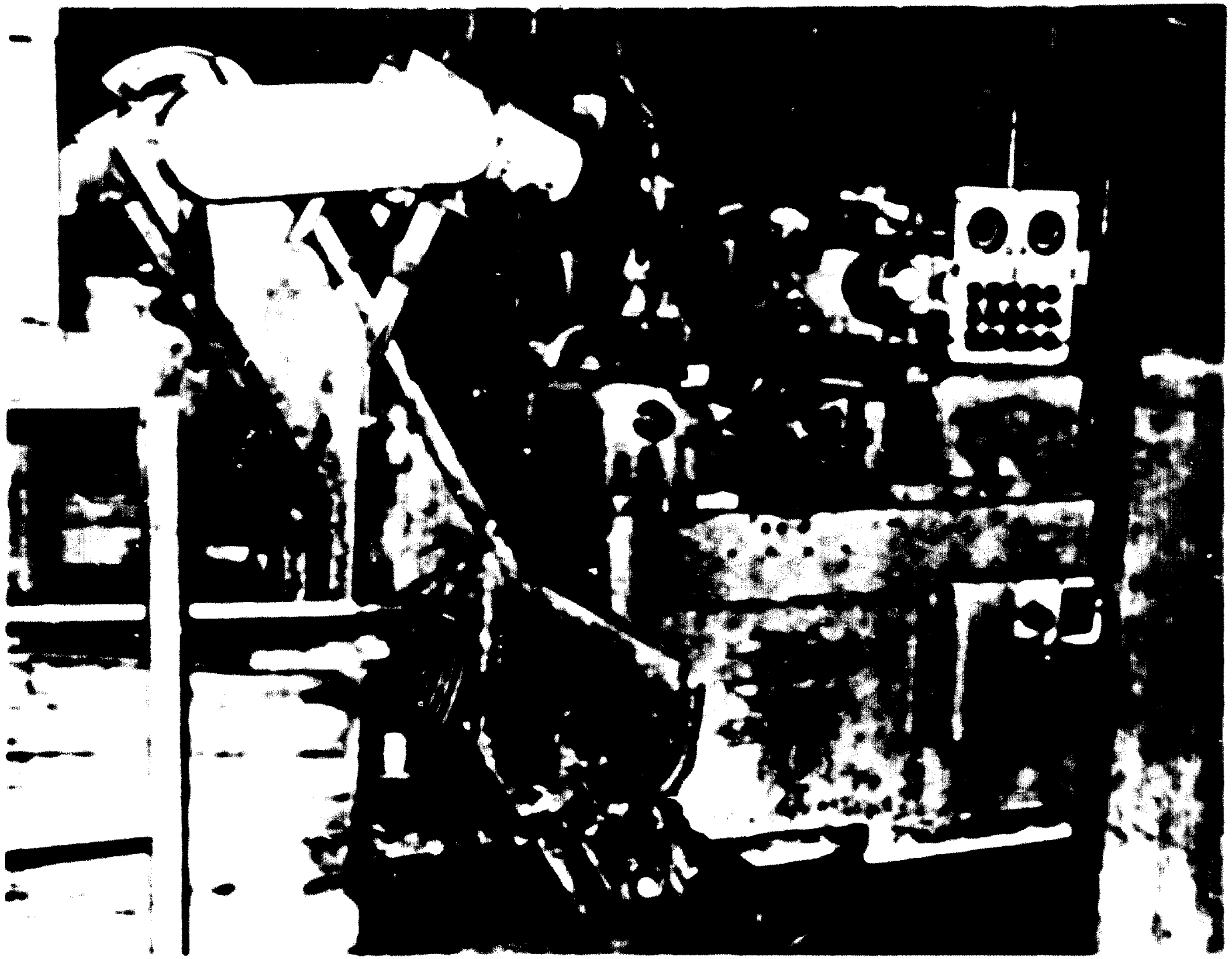


Figure 1

Contour turning ball stud heads

Figure 4

1" upsetter for controlinks

32. Obviously this manufacturing method was not feasible for the developing country where the production volume was small and the lot sizes seldom exceeded 5,000 pieces. It was not feasible to use the cold heading method because cold heading steel was unavailable in the country. Nor could the investment in a progressive cold header (approximately US $250,000) and its intricate tooling be considered in view of the low volume and absence of adequate facilities for producing the header tools. Similar considerations applied to the special machine for drilling and counter-sinking the cotter hole. A simpler manufacturing process was devised for small lot production, adapted to the available raw material (hot rolled steel bars) to conventional standard machine tools, and to medium skilled labour. After the blanks are cut, they are heated in a small furnace and the head is hot-forged on a conventional punch press. The forged stud blanks are then finish-turned on contour turning lathes equipped with duplicating attachments; one lathe (figure 3) finishes the head and another such lathe finishes the shank at a rate of 50 pieces per hour for each operation. The drilling and counter-sinking of the cotter hole is done on conventional drill presses, and the forming of the thread on a regular thread roller.

33. Even this sketchy description and comparison of the two methods discloses several reasons why the over-all manufacturing cost of the simpler method is unavoidably higher, primarily because the increase in labour by far exceeds the savings due to lower wage rates. The scrap rate also plays an important role, being very low in the automated method and relatively high in the simpler method with its dependence on the human element.

34. The second example compares the methods of forging a controlink. This forging, with its bends and the close tolerance in the angular and dimensional relations of its two forged ends, is produced in the United States plant on a 3" upsetter (figure 4). Each end is finish-forged in one heat provided by an automatic induction heating installation not requiring any attendant; only one operator is needed to produce these accurate forgings at a rate of about 120 pieces per hour. To duplicate this set-up would have been entirely uneconomical at the start of the plant operation in the developing country, not only because expensive equipment would have operated by a few hours per month and would have involved several costly set-up changes, but also because at that time power shortages precluded the use of electric induction heating. Figure 5 shows a somewhat primitive, but temporarily adequate, arrangement which was devised.

Figure 5

Heating end of centrelink and gathering on punch press

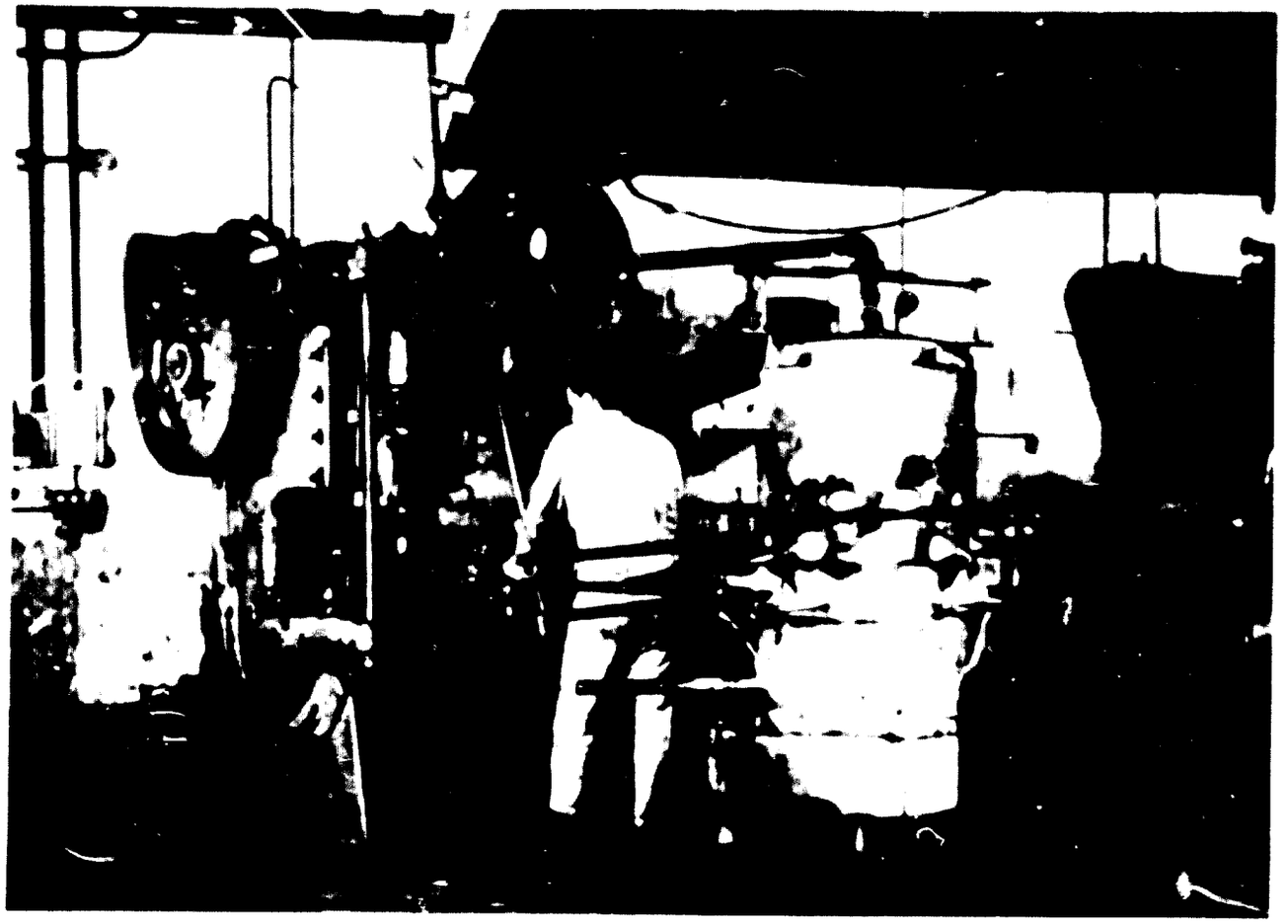


Figure 6

2-½" upsetter for vertical sockets

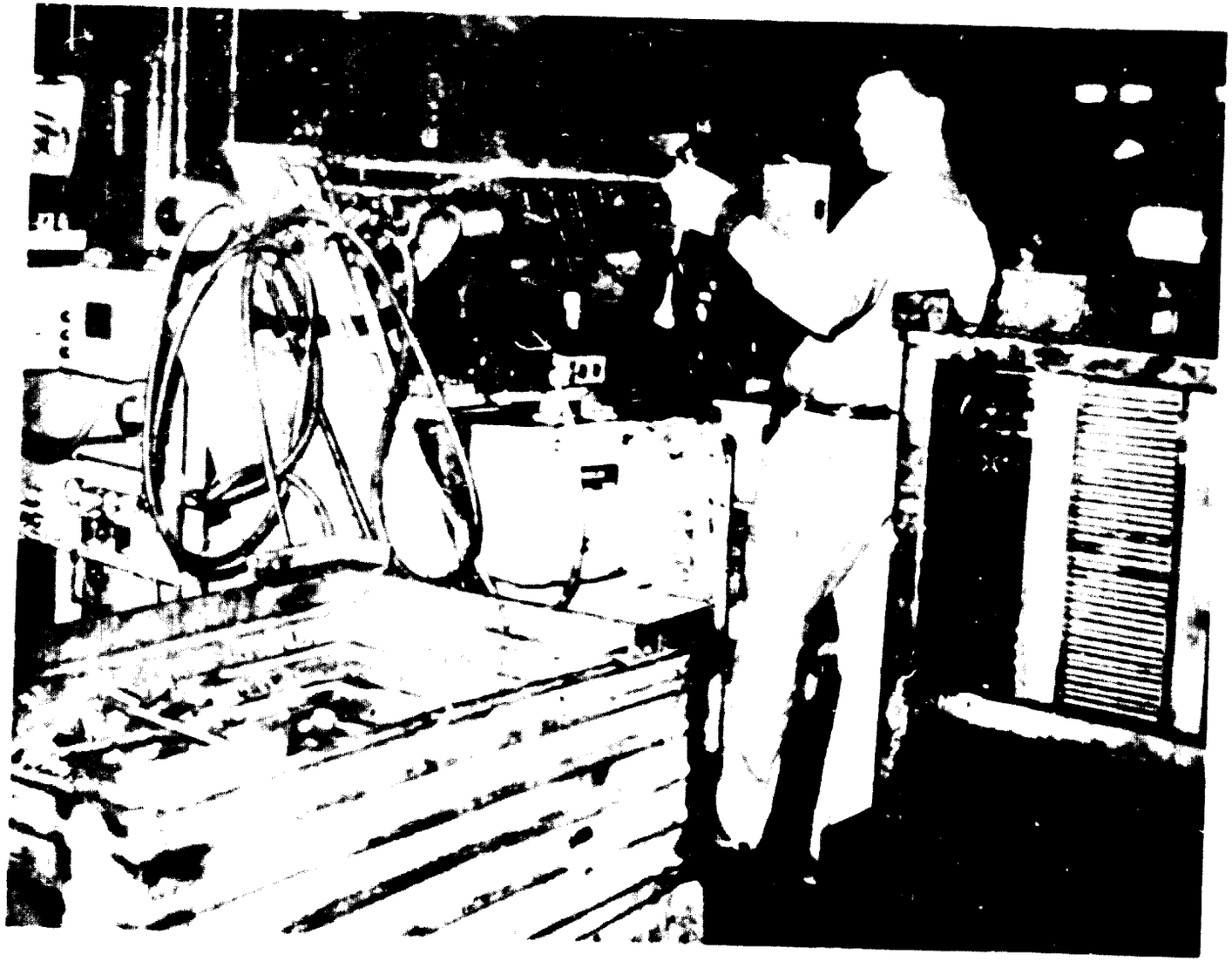


Figure 7

First forging operation of sockets on air hammer

In the foreground is an oil-fired pigeonhole heating furnace and in the background a conventional punch press for the several gathering and forming operations, each requiring an uncomplicated die set-up. At the time of this writing the increase in the automotive production of the country, the required skill of the workmen and the increased availability of electric power have created conditions under which the installation of an upsetter, including an induction heating device, becomes possible. An added inducement for this investment is the expected and desirable improvement in the quality of centrelink forgings and the elimination of a high rate of rejects.

35. The third example compares methods for the production of vertical sockets of two similar types - the short stem socket and the long stem socket. Both are produced on identical or similar equipment. The comparison of the methods for the major manufacturing operations brings out the influence of high volume and the necessity of labour savings in view of the high wages in a country such as the United States of America and the influence of the opposite conditions in the automotive component manufacturing plant starting out in a developing country. The forging of the socket is performed in the United States plant on a 2-1/2" upsetter (figure 6) equipped with a magazine feed of blanks to an induction heating device. The forging is produced to close tolerances, permits an accurate location on the subsequent machining operation, and only a small amount of stock for machining needs to be allowed.

36. One operator's output is approximately 150 pieces per hour. Compare this method with the steps employed in the forging plant of the developing country. The blanks are heated in an oil-fired furnace, where the proper temperature is checked frequently by means of a pyrometer. The end is then blocked on an air hammer (figure 7), reheated, and the final forming is performed on a home-made drop hammer which requires the services of three men. Altogether it takes six men and approximately 10 per cent more steel to produce about 60 pieces per hour as against the one United States operator producing 150 pieces per hour; but the forging equipment was available and operating in the developing country, whereas the American-type installation would have been an investment of close to US $150,000. No doubt such an installation will be made eventually, but the initial primitive set-up satisfied an immediate requirement.

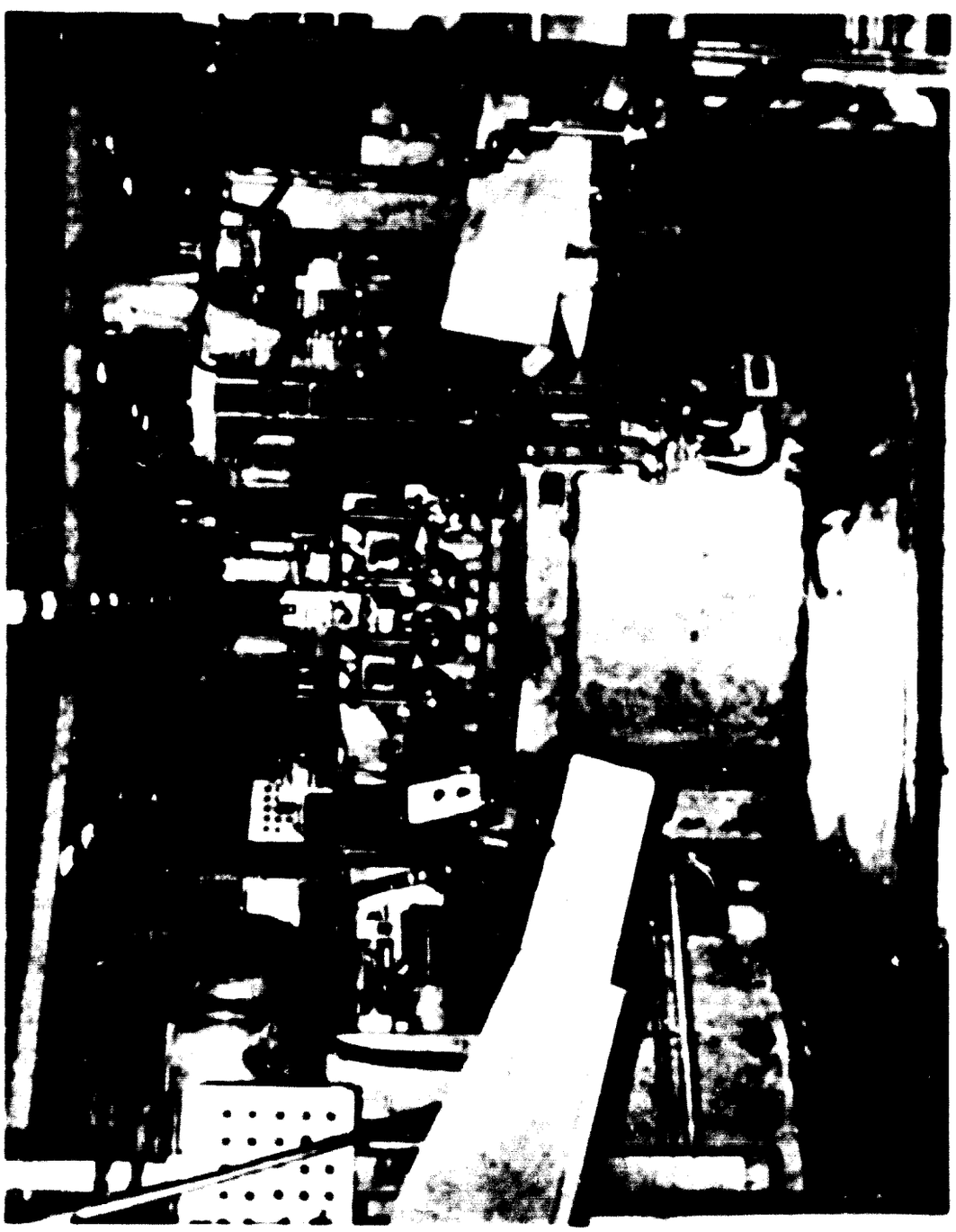


Figure 8

Special machine for finishing socket ends

37. The machining of the socket head also leads to an interesting comparison of methods. The United States plant has a battery of special seven station index machines and each machine completes the entire head at a rate of over 500 pieces (figure 8). The costly tools and set-up procedures are economical for the large volume and the frequent long runs. A complete set-up requiring about six hours is seldom needed; most changeovers are accomplished with a partial set-up in two hours, which limits the economic lot size to a minimum of 5,000 pieces. No such conditions exist in the developing country where the several machining operations are not combined and are performed in separate steps on conventional drill presses at a rate of 20 pieces per hour.

38. A hollow milling operation on the back of the socket, as performed in the United States plant, is shown in figure 9. It is a 10-spindle rotomatic where the table and the tool head rotate together. This arrangement requires 10 sets of identical tools and a very precise set-up; but the high output of 700 pieces per hour in a concentrated space is suitable only for very long runs. The same operation is performed in the plant of the developing country where the lots are small, on single spindle screw machines at a rate of approximately 60 to 70 pieces per hour.

39. The assembly of the ball stud to the socket includes the insertion of a spherical bearing, spring, cover plate, lubricant, and other parts, depending on the particular design. A special index-type assembly machine for short or long stem sockets is shown in figure 10. It works in the United States plant in conjunction with a hydraulic press seen on the right side of the photograph. The various parts and the lubricant are fed automatically to their respective stations and the finished assembly lubricated and sealed, leaves the machine at a rate of 300 socket assemblies per hour. Compare this operation with the method in the plant of the developing country where all the parts are assembled by hand and the only machine operation is the final closing of the assembly on a home-made spinning machine (figure 11) built from an old drill press and actuated by a hydraulic cylinder at a rate of 100 pieces per hour.

40. One more example is a foundry for the production of piston ring castings to supply a piston ring machining line. No source of quality castings is available in the country and the import is prohibited. It becomes necessary to install a complete minimum size iron foundry, which nevertheless has excess capacity and fills the current requirements by operating only two days a week. It is obvious

Figure 9

10-spindle Rotomatic for hollow milling back of vertical socket

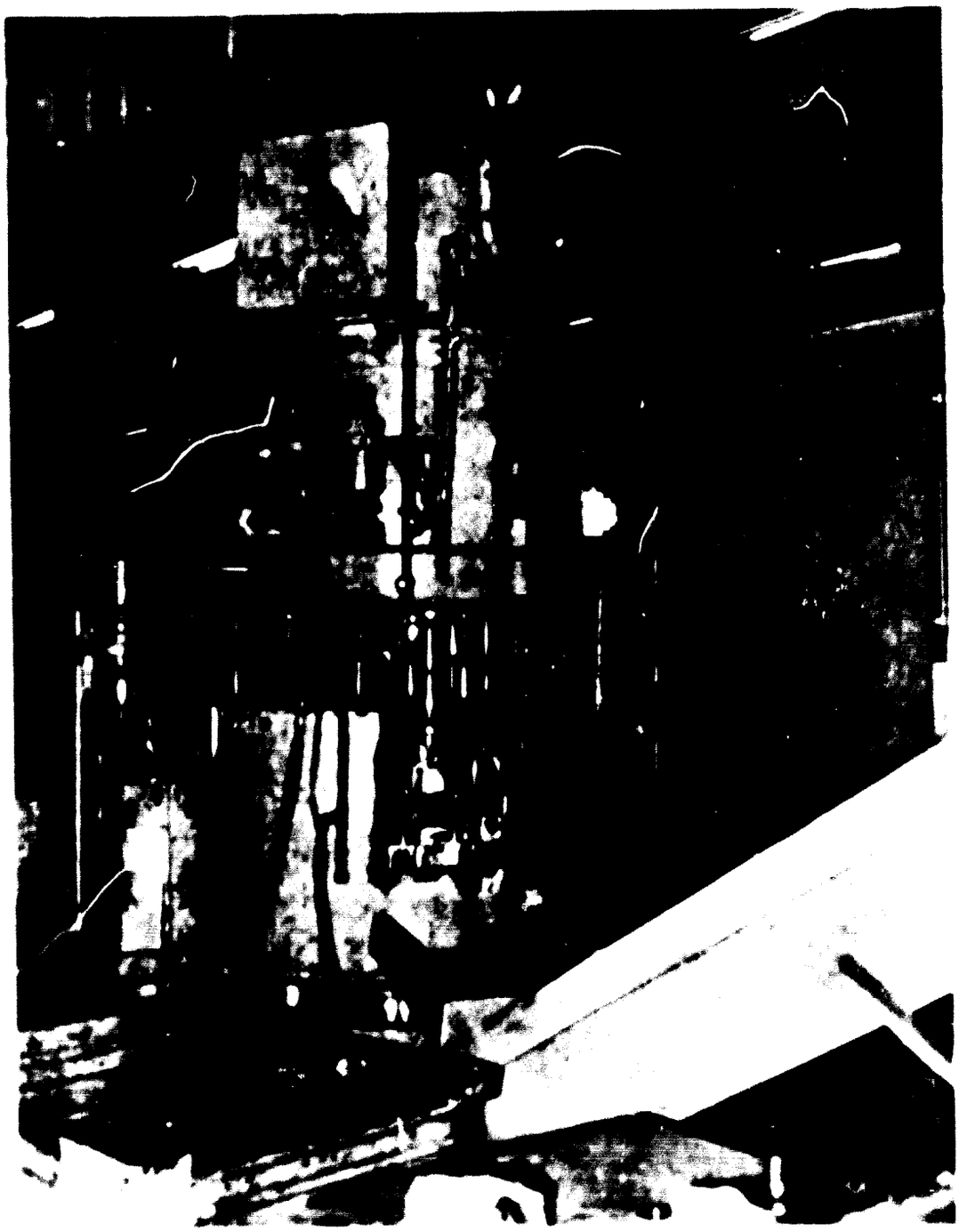


Figure 10

Semi-automatic assembly of sockets

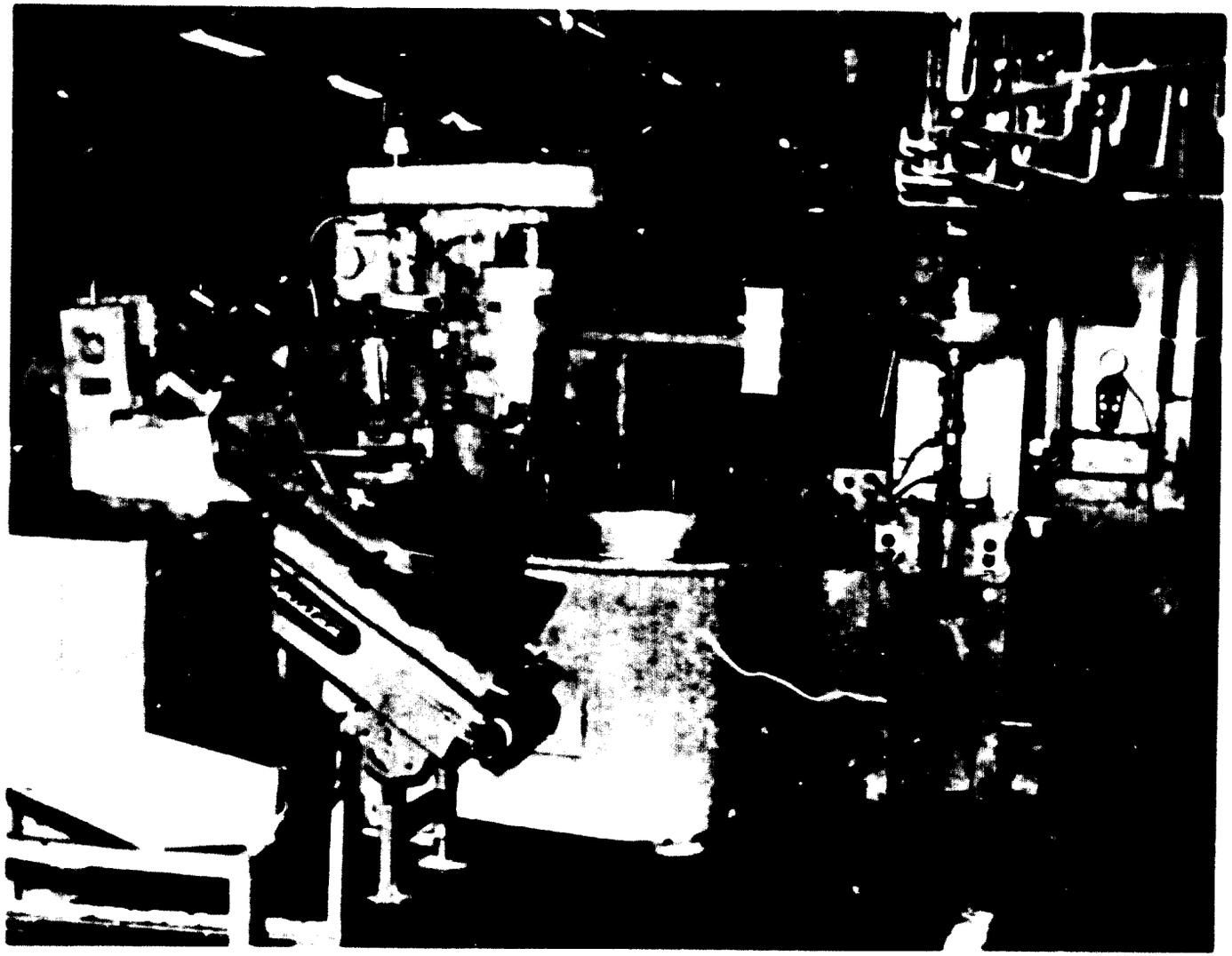
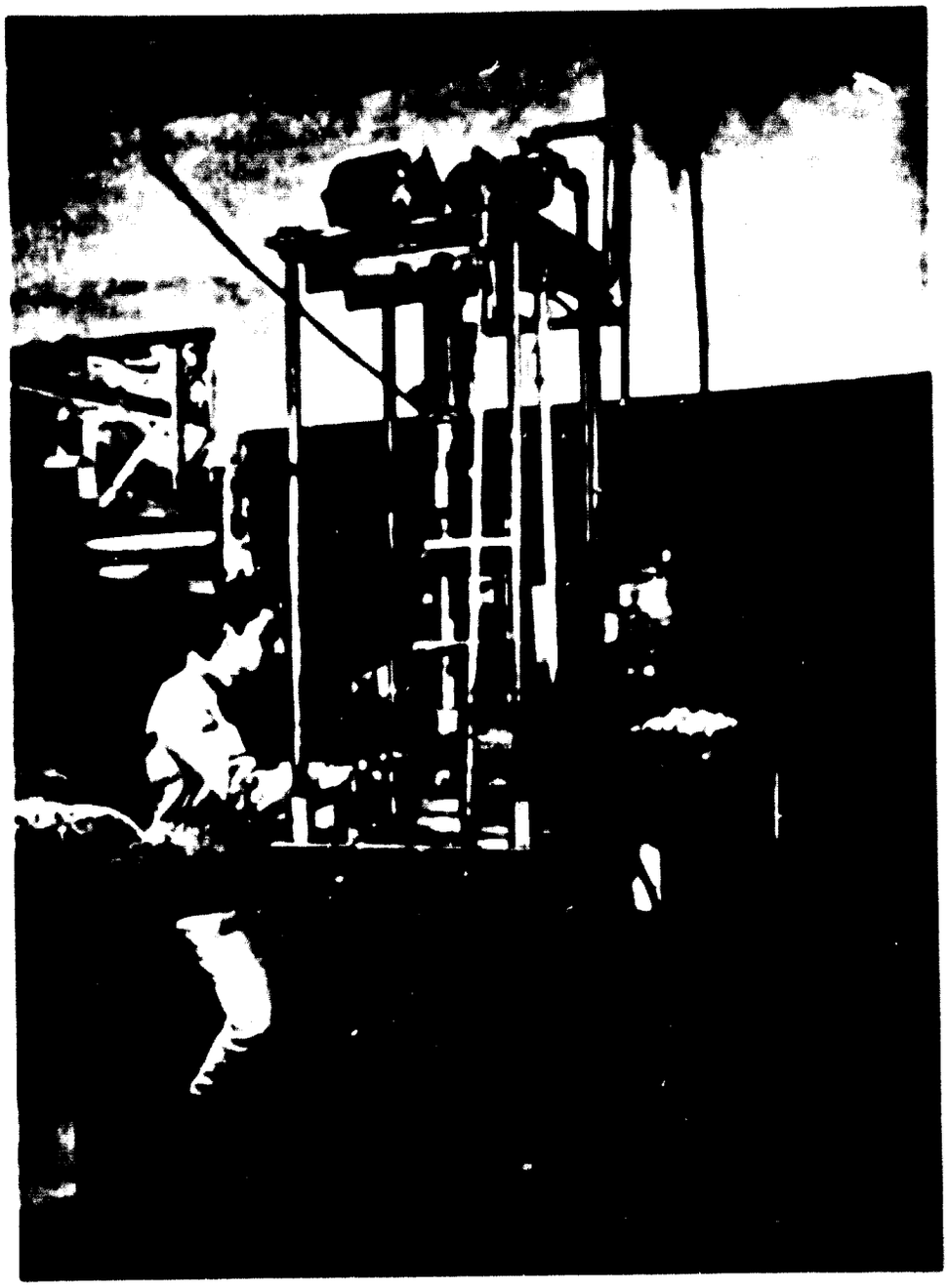


Figure 11

Spinning machine for assembly of sockets



that a foundry cannot be operated economically on such an abbreviated schedule. Two views of this foundry are shown: figure 12 illustrates the pouring of the metal from the cupola ladle. Mechanization of the pouring operation was not adopted because this added investment would have only increased the losses. On the other hand, the sand handling and molding facilities are modern and of the latest design to insure a high quality of the piston rings castings. There is the expectation, if not assurance, that an eventual growth of the original equipment and replacement markets will generate enough volume for an economical utilisation of the foundry capacity.

VI. LONG RANGE PLANNING: THE CASE OF BRAZIL

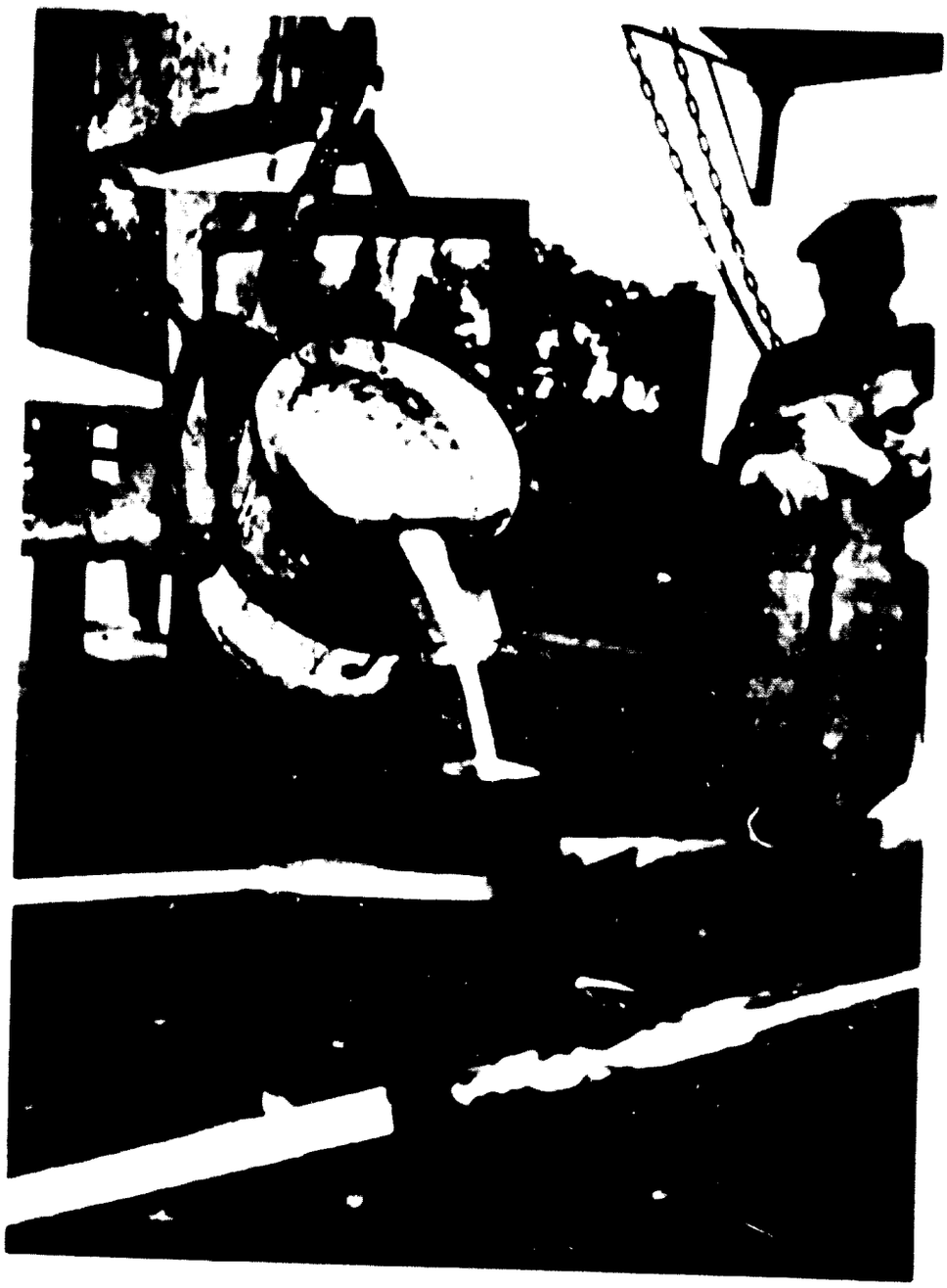
41. To assemble or build automobiles in a developing country, it is necessary to create a national automotive component industry. In fact, the presence of automotive parts manufacturers and a plan for a further growth and development of this industry are more or less prerequisites for the establishment of vehicle factories. Plans for the introduction of automotive production to a developing country frequently originate from the government and are accompanied by laws concerning the types, quantities, time schedule, financing, taxing policies, percentage of national content, investment sources, technical assistance from abroad, location of plants, procurement of raw materials, sources and training of labour. Such an integrated plan, to have a chance for success, is best worked out in co-operation with the present and future automotive producers - domestic and foreign - and must be flexible enough to adapt to unforeseen or changing conditions.

42. Possibly the best way to deal with the aspects of such planning, although it will vary from country to country according to the conditions encountered, is to select an actual case which was successful and is well documented. The principles embodied there may serve as a guide for similar projects in other countries.

43. The example selected for this paper describes the introduction of the automotive industry in Brazil, the long range plan developed by government agencies and the important role played by the manufacturers of automotive equipment components. Brazil had a modest number of vehicles prior to the Second World War, mostly imported from the United States. A few trucks of a United States make were assembled locally from imported components. Ninety per cent of all replacement parts for maintenance of the vehicles on the road were imported from

Figure 12

Piston ring foundry - pouring from cupola ladle



the United States. During the Second World War the source of replacement parts was lost and the stocks in the hands of distributors were exhausted in a very short time. This situation created the necessity to produce needed repair parts domestically, and several enterprises were organized for the manufacture of automotive components. True, the components were frequently copies of poor quality, made without benefit of the original engineering drawings and specifications, often fabricated on primitive equipment from inferior substitute materials. These parts were at the start costly and may not have lasted long, but at least they kept the trucks and cars rolling. What is equally important, the new plants, though somewhat primitive, provided a training ground for management and workers, grew in size, number and efficiency, and became an essential nucleus for the post-war growth.

44. The post-war growth of the automotive component industry may be attributed to several key factors. The influx of the badly needed truck fleet opened up an attractive market for components. Several local parts makers invited well-known foreign parts manufacturers to participate in the growth through licensing or technical assistance agreements or the creation of partnerships that provided know-how, equipment and capital. At the same time, the intensive import of trucks so depleted foreign exchange funds that the Brazilian Government had to put severe restrictions on the import of automotive components and finally prohibited the import of certain parts already manufactured in Brazil. This action served as a further stimulus for foreign manufacturers to set-off the loss of this export market by participating in the creation of the Brazilian national automotive industry.

45. However, the main contributing factor to the successful establishment and growth of the national automotive industry was a thoroughly prepared and executed plan on which several governmental offices collaborated, but which was formalized, centrally directed and supervised by an executive governmental body created on 16 June 1956 and called Grupo Executivo da Industria Automobilistica (GEIA). The "father" of GEIA and its capable director was Admiral Lucio Meira, who initiated the programme for the establishment of a Brazilian automotive industry and carried it through to successful completion. This programme was really part of a national economic development plan conceived as Plan of Targets (Plano de Metas), the automotive plan having been assigned the designation Target 27. The history of the first two years of GEIA and Target 27 is described

in a booklet published by the Office of the President in 1959 under the title Meta 27: Industria Automobilistica. The author of this paper has drawn on the data contained in this publication in addition to his own personal experience to condense in a few following paragraphs the salient features of the plan and its realization.

46. Within the over-all economic plan of targets, the Government gave the highest priority to the automotive industry and granted special preferential treatment to the import of machine tools needed to establish the automotive plants. GEIA was able to function effectively because its members were assembled from high ranking officials of various government departments. Therefore GEIA decrees represented simultaneously and automatically the decisions of these participating government organs, such as the Minsitry of Public Works, the Finance Ministry, the Bank of Brazil, the National Bank for Development, Customs Office. GEIA thus could provide immediate incentives for the planned development of the automotive industry by instituting stimuli falling into the following general categories:

(a) Foreign exchange taxes graduated in such a manner as to give most favourable concessions to the import of equipment needed in the manufacture of components for vehicles of prime importance in the plan;

(b) Fiscal incentives, particularly in the form of a waiver of import duties on authorized equipment and on components not yet produced in the country;

(c) Credit regulations of foreign exchange and loans from the Development Bank for the construction of automotive factories;

(d) Commercial stimuli by establishing protective exchange and customs tariffs against the import of foreign vehicles and components already available from domestic producers.

47. The result of these incentive decrees was an amazing response from domestic and foreign manufacturers which put GEIA into the difficult, but pleasant, position of selecting the best from the many projects submitted for approval. A significant feature was the interest of domestic and foreign companies in the manufacture of components heretofore not produced in the country. The GEIA plan (Target 27) envisaged an automotive industry organized on the concept of horizontal integration. The regulations of GEIA therefore divided the companies applying for participation in the plan into two categories: one category being producers of automotive vehicles, the other category manufacturers of automotive parts or subcontractors to the vehicle industry. How important this second category was to the realisation of the entire plan is a subject of a separate chapter in the above-mentioned publication.

48. The Brazilian automotive parts industry, whose small beginnings during the Second World War were mentioned before and whose original aim was a service to the replacement market, underwent under the GEIA plan a transition to the status of an original equipment supplier or subcontractor to the national automobile builders. According to a GEIA statement, the parts industry's role in the establishment of a local automotive industry was decisive, thanks to its superior faculty to adopt modern manufacturing techniques and the extraordinary capability of its management to carry out the projects formulated to progressively increase the local content of the vehicles scheduled for production under the GEIA plan. The same stimulants as those offered to the vehicle industry were also available to promote the growth and improvement of the subcontractor industry.

49. The GEIA report states that in December 1956 the investment in automotive parts plants was estimated at US $117,100,000, whereas in the same date the total investment in the vehicle manufacturing plants reached a level of US $90,500,000. When the 1960 target was reached, the investment (as planned and approved by GEIA) increased to approximately US $400,000,000 in the parts industry as against US $300,000,000 in the vehicle building industry. In this connexion it is interesting to note that, in contrast to the historical development in the United States and in Europe, the automobile industry at the start of its establishment in Brazil already encountered a flourishing and growing parts industry developed preponderantly by local capital and local management. The GEIA plan strove to preserve this found while encouraging technical assistance from abroad and welcoming foreign capital that brought with it technical advancement and know-how. Whereas the vehicle building section of the automotive industry calls for foreign capital by reason of its large financing needs, the component manufacturing sector preserves the predominance of local capital.

50. While the plan for national integration was generally followed, certain natural obstacles and difficulties were encountered and had to be overcome. It may be useful to list them here, because it is fair to assume that they are typical and could occur in any future plan for a domestic components industry.

51. An automobile maker of international reputation has the natural desire to maintain his prestige of excellence for the subsidiary being established in the developing country. He would like to use, therefore, his reliable sources at home as suppliers of many precision components for the subsidiary. This

difficulty was often favourably resolved, when the vehicle manufacturer induced his reliable component suppliers to produce the same parts in Brazil or to license their production by local firms with adequate technical assistance accompanying these arrangements. An even more favourable condition was created when these new parts makers could also produce components for other vehicle manufacturers, the increased volume and experience contributing to more economic operation and to lower costs.

52. Another difficulty resulted from the justified demand by the vehicle manufacturers, that the parts furnished to them by local firms, met the standards of their rigid specifications and tolerances; whereas many local producers of automotive parts had been accustomed to work to less rigid standards while they had been supplying their products to the replacement market only. These suppliers often needed not only retraining in their attitude towards quality control and procedures, but they also needed better manufacturing equipment and improved methods. Some vehicle manufacturers had the tendency to make such parts themselves rather than to buy them from subcontractors.

53. A financial obstacle to GEIA's horizontal integration concept lay in the very nature of capital sources. The vehicle manufacturers, benefiting from their long established ties with international sources of capital and their know-how of financing new enterprises, had much easier access to capital funds than the new national firms.

54. Possibly the greatest threat to a horizontal integration of the automotive industry, and therefore a threat to the components manufacturers, lay in the existing fiscal regulations of Brazil which imposed state sales taxes and federal consumer taxes. The state sales tax applied to every transaction as materials or semi-finished products moved from one firm to another - the consumer tax applied to the finished component as well as the vehicle itself. This cumulative taxation would have been prohibitive. GEIA had to advocate needed fiscal reforms.

55. Other general measures were devised to insure the success of the plan. These measures, while designed to further the entire automotive industry, were essential to the success of developing the Brazilian automotive parts industry. Foreign exchange had to be provided and the plan called for US $510,000,000 to cover the period from 1957 to 1960. Of this amount, US $100,000,000 were allocated to pay off the principal and interest spent by vehicle and parts manufacturers for purchasing machine tools abroad. The remaining US $410,000,000 were allocated

towards purchase abroad of automotive components hitherto not produced in Brazil but needed during the first three years of the plan while domestic production was being introduced. Incidentally, the major portion of the equipment imported from abroad was acquired without payment, as it constituted a direct investment by foreign firms not requiring exchange coverage. Equipment worth around US $200,000,000 was thus brought into the country with GEIA's authorization, the parts industry received about 25 per cent of that.

56. Other foreign exchange funds were earmarked for purchases of raw materials, remittance of profits to foreign investors and of royalties or technical assistance fees. It is however significant that the total amount of foreign exchange allocated for the development of the national automobile industry can be considered a saving of foreign exchange, because without domestic production either greater foreign exchange funds would have had to be expended to import the same number of vehicles as were produced at home, or fewer vehicles would have been added to the national economy by holding the foreign exchange expenditures to the same level.

57. Due consideration had to be given to the task of providing adequate manpower to the automobile industry. The GEIA plans were concerned not only with the problem of how to channel some 100,000 additional workers into the new industry in the first three years of the plan, but also how to train and educate supervisors, technicians, engineers and managers. These tasks were undertaken in collaboration with industry groups, other government agencies and institutions of higher learning.

58. The ever-present problem of quality was also of concern to GEIA. The efforts expended in this field were mostly directed toward the parts industry. As mentioned before, the Brazilian parts industry initially had to fill a void in the supply of replacement parts during the Second World War. The standards of quality in an industry created under such conditions, with a few exceptions, left much to be desired when compared with the rigid quality standards of the foreign parts makers. With the advent of the first vehicle assembly plants and later vehicle manufacturing plants in Brazil, adherence to standards and tolerances became not only a requirement demanded by the customer, but also a matter of prestige for the national product. Inasmuch as the promotion of quality was primarily the responsibility of the industry, GEIA undertook to support such efforts by arranging with qualified schools to give assistance to the parts makers, particularly the smaller ones who needed it most. Vehicles produced at that time in Brazil were

of seven different local origins, each employing its own standards. This was a handicap for the parts manufacturers and posed considerable quality problems. GEIA initiated a programme to develop Brazilian national standards to supplant the several foreign standards which would lead, it was hoped, to components common to several makes of vehicles.

59. In concluding this very condensed case history, it should be understood that it has been presented not as a plan to be copied by other countries but as an illustration of basic problems one may expect to face in developing an automotive parts industry, and what solutions have been devised in the particular case of Brazil. Results seem to indicate that long range planning achieved success. From 1956, when 6,087 vehicles were assembled in Brasil and when only about 40 per cent were of local content, the parts industry grew in volume and quality enabling it to supply a practically 100 per cent local content to over 185,000 vehicles built in 1965, and to produce all the parts required to maintain 1,900,000 registered vehicles.

VII. A LOOK INTO THE FUTURE

60. The automotive parts manufacturers who supply the fully developed automobile industry in their own country will be for a long time a source of replacement parts in developing countries. While they compete for a place in the export market, they also will be collaborating with developing countries by providing capital and technical assistance to build these plants for the production of automotive equipment components. The inducement for this participation has to come from a sufficiently large demand and from government measures offering an incentive to foreign companies to share in the industrial development of the country.

61. The question may be asked, how large is the potential of the automotive component market and how can it be related to the demand for original equipment and for replacement parts? Some statistics are available which make it possible to arrive at a rough estimate. For instance, a study of the Japanese automobile parts industry undertaken by a German engineering group in 1964,[1] states that suppliers to the Japanese automobile factories (raw materials, semi-finished

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1/ Verband der Automobilindustrie (1964) Die japanische Automobil-Teile-Industrie

products and finished parts) share 55 per cent of the manufacturing value, of which 30 per cent is represented by parts with a tendency to increase this share. (In the Federal Republic of Germany the suppliers' share was at that time 60 to 65 per cent.) Furthermore, 76 per cent of the value of the total Japanese parts production went to original equipment and 24 per cent to replacement parts. By relating these ratios to the Japanese automobile vehicle production figures and the number of registered vehicles, it appears that the parts industry furnishes approximately US $500 worth of original parts per manufactured vehicle, and an average of US $100 worth of replacement parts for each registered vehicle. Because of the higher proportion of trucks manufactured and registered in Japan than in other automobile producing countries, these estimates may be applied for developing countries where the demand for trucks and buses is relatively higher than the demand for passenger cars. Thus, a country with 200,000 registered vehicles provides a market for a volume of repair and replacement parts valued at approximately US $20,000,000. A country assembling and manufacturing 200,000 vehicles per year may support a domestic parts industry with a yearly production of US $100,000,000 in locally produced parts.

62. The steadily increasing demand for automotive vehicles in the developing countries will generate pressures to create or expand domestic automobile parts industries. It is hoped that this paper has furnished some guidelines for determining the feasibility or advisability of such plans, how to avoid errors and how to tailor these undertaking to the needs of a particular region and market.

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