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MAINTENANCE AND REPAIR OF SELECTED AGRICULTURAL MACHINES AND IMPLEMENTS

by

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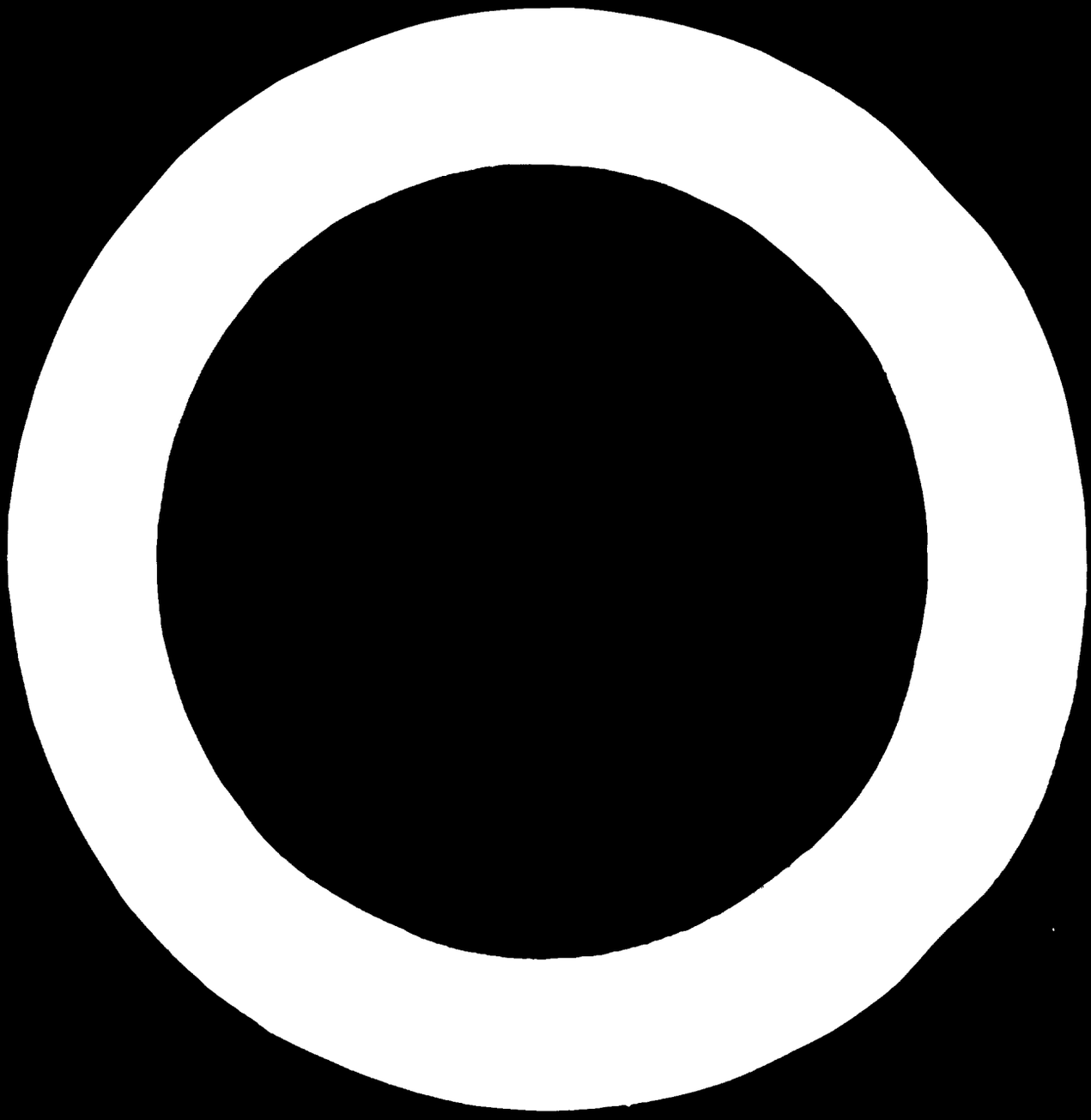

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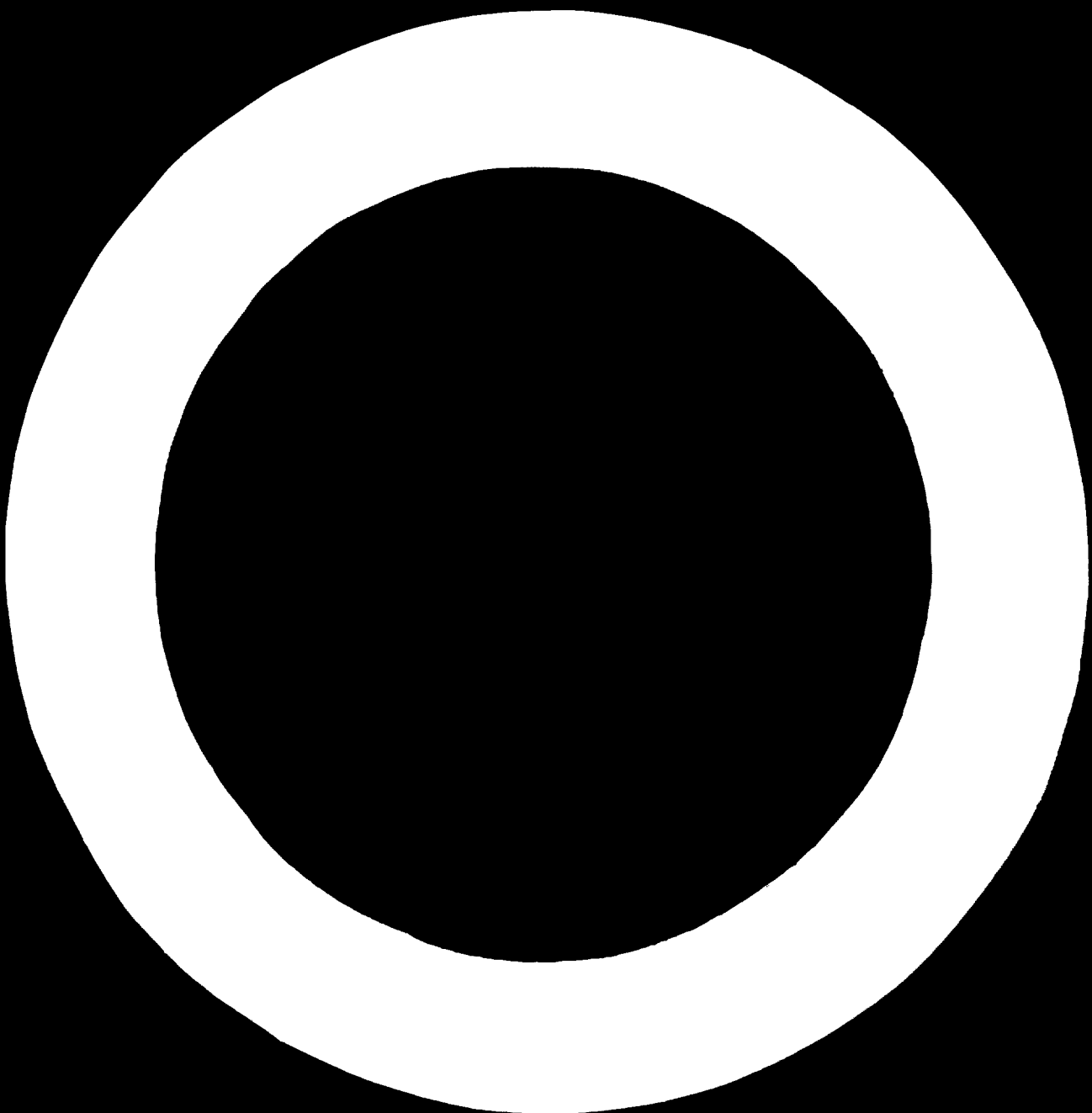

P R E F A C E

An economical mechanisation of agriculture to improve land-cultivation and to raise agricultural production depend by a great deal on the duration of life of the machines and implements in use.

To obtain a maximum duration of these materials "Maintenance and Repairs" should be improved systematically and carried out according to a "Service-Plan."

Today in developing countries the service-organisations are still facing problems with material and personnel in their efforts to reach a satisfactory standard for Maintenance and Repairs.

So it is advisable to base the Service-Plan itself on a few main points marking the conditions existing in those countries.

I. Study of the development programm for the agriculture to get a summary over the total number of machines and implements to be maintained in the different areas. This consequently allows to fix the total number of workshops and Service-stations.

II. Selection of tractors in relation to Farm-sizes and in accordance with the methods of soil preparation to determine the size of the respective workshops, their equipment and staff.

III, Selection of implements in accordance with tractor sizes and types as well as with conditions of soil and according to working methods.

The kinds of implements consecuently determine additional workshop equipment, spare part-requirements and the sizes for workshopstore-rooms and yards.

IV. Training of operating personnel in order to reduce costs for repairs caused by incorrect driving or operating. Training of workshop personnel.

V. Projection of engagement for machines and personnel in particular on big farms to achieve full occupation of personnel during the whole year and to obtain a maximum of materials utilization.

VI. Cooperation with allready existing service groups in action for the various makes of tractors and to incorporate them in the serviceplan in order to gain on the presence of allready qualified workers and special workshop sections with the aim at an earlier and easier completion of the program set for improvement of maintenance and repairs.

S E R V I C E - P L A N

Resulting from the introductory survey over the problematics for the mechanisation generally a systematical realisation of the improvements of standard of repairworks and regular maintenance is now pointed out with the intention to show a way to meet with the requirements for.
Tractors, implements and equipement have been seen in fact on many places in very bad conditions or used in a wrong way or completely out of action as a result either from a lack of

information and acquaintance, a lack of spareparts and repair facilities or missing of a strong management guiding the service-organisation.

Machines and implements need to be maintained regulary and correctly following the manufacturers instructions. So an appointed management is confronted with the main tasks to build up or complete a service organisation and to direct it for the sake of the country's economy under consideration of the following fields.

These fields or tasks respectively have mainly been found in developing countries and beside of the suggestions for carrying-out practically the necessary works or operations on selected machines and implements and moreover beside of proposals for running the also important administration it will be tried to complete the explanations by description of actual examples.

A/ <u>Structure of the Service-Organisation</u>

Whether machines and implements are imported by companies and sold on a free market only or exclusively ordered and distributed by a statecontrolled department or whether both systems are competing, the requirements to keep these materials in good conditions are the same.

However a service for certain makes of machines is more or less granted allready by the responsibility of agents and dealers in view of normal competition and according to contract with the manufacturer the Central Service-Department - appointed by the government should be given the absolut priority. With full authority the Central Service-Department

works out directions for the state-controlled workshops and keeps permanently contact with those private workshops in charge with maintenance for materials delivered on the free market.

With its seat in the country's capital or close to the ministery of agriculture respectively the Central Service Dept. activity begins allready with advising for orders of machines implements, spareparts, tools and equipements from abroad as wel as from the local market.

It controls distribution of material and engagement of personnel while branche offices in provincial towns are observing these movements in their surrounding areas including the observation of activity of local dealers.

Beside of normal administration the Central Service Dept. is further concerned with tasks such as cooperating with technicians from agricultural schools, research institutes, testing of new types of machines, organising of training courses for drivers, operators and mechanicians.

In connection with representatives from factories particular measures of maintenance according to climate altitudes, roads, distances between farms and workshops, are to be pointed out and fixed.

Alltogether is to gain more and more experiences and to raise its efficiency to the benefit of farming.

As an example in IRAN up to 1965 Imports and sales of tractors and implements were free with certain restrictions in view of quotes. Sales where supported by a governmental credit system.

Although dealers workshops were obliged by the factories to do "After sales Service" and maintainance at first it has proved to be insufficient because of missing facilities lack of qualified personnel or for reason of high travelling expenses when carrying out field service at very distant places to be reached only over rough roads. The general agents for tractors in Teheran had well equipped workshops, trained staff and reasonable stocks of spares but only a few equivalent branches or workshops under contract in the provinces. The rest of subagencies consisted in dealers only without own service-facilities and the owners of agricultural machines were forced to make use of any local workshops or mechanician sometimes not sufficiently acquainted with those makes and types Tractors had to be driven over long ranges 50 miles or more for simple repairs to be done and for more complicated repairs engines or vehicles must have been loaded on a truck and brought to town by suffering from high transport costs and losing of time.

This kind of service organisation was good enough for machines running in the vicinity close to the agents places whereas distant farms remained at a disatvantage and unable to keep the materials in order due to lack of assistance. When passing in those years distant villages or farms one could see a tractor standing in a yard completely out of function after a few thousands of servicehours partly dismantled and rusty. Or a plough with bent parts, deformed, welded, reinforced and bent again not suitable anymore just after one operating season.

As another samples an irrigationpump-set with defective engine, poor village people arround and helpless what to do or a combine under repair at a village-workshop with the most primitive tools and equipement.
No doubt those people tried their best to help themselves and to overcome the difficulties but under those conditions much capital was wasted.
Since the Service-Section of the Iranien Plan-Organisation took over full-power it became better. Formerly only responsible for machines and implements supplied by the Plan-Organisation itself it got subsequently control also over the maintainance for machines and implements brought into the market by privat companies.
The financial aid by the above mentioned credit system obliged the agent or dealer to look regularly after the goods he has sold. To garantee the purchaser a real "After sales-Service" and furthermore a maintainance of his machines or implements, the Service-Section in Teheran brought out a printed form marking all necessary works to be carried out on an acricultural machine or implement. Inspections are ordered twice a year and works to be done according to the job-list on this printed form. After completion the vehicle holder had to sign the paper to confirm the correct execution of the job.
This form was considered and handled like a document and helped a lot to improve the standard of maintainance.
Unless this paper was signed by the farmer the dealer was refused to get the next instalment paid by the credit institut.

So the workshops were forced to do a complete check-up or to send a Service-Car around for inspections without regard of distances. The mechanicians and fitters were watched to do a complete and accurate work in view of the necessary confirmation through the farmers signature and finally the farmer or owner of tractor himself was satisfied.

Today in Iran since 1966 the import and distribution of wheel-tractors are with a few exemptions concentrated and monopolised to only one make with the aim to turn to national production step by step.

This move involved further tasks for the service-Dept. as many private workshops connected to other makes and allready specialiced for, were with-drawn from the service-network. So the Service-Dept. had to increase the number of own branches and to contract local companies or workshop. This sole competence beared more responsibility and also a little change of administration and activity. Simplified on one side by contacts to only one manufacturer abroad, more difficult on the other side by administrating of the whole workshop-network alone, handling of all warranty claims filing of all vehicles and implements distributed and being more dependent from the rules for industrialisation.

B/ <u>Number of required Service-Bases and their Sizes</u>

The Process of mechanisation covers self-evidently more and more agricultural areas, where no workshops are yet available. So it is again the central service-department first which registers this expansion and plan the adaptation of the network of service stations and repairshops in

appropriate ranges.

No Matter whether private companies take the initiative to build bases or the development board is involved the considerations for planning remain rather alike and depend on: geographical conditions, distances, road-connections, numbers of machines foreseen at the final stage of mechanization, on the calculation of rentability by estimating of building sizes, the number of staff and service-cars the stock of spares and other materials.

Based on the total number of workshops and branch offices, their equipments and staff the service-management is able to open the budget for a year or an entire plan-peridde as an essential part of the financing program for mechanisation. This so far as the service system is in majority state-controlled like in IRAN now.

From private side usual business extensions and the competition only induce to build up more bases after consideration of all risks and it needs careful calculations in view ofthe amortisation.

C/ <u>Maintainance of Machines and Implements</u>

A Selection of certain machines and implements which are mainly in use in developing countries shall be taken as a basis for recommendations to practical maintainance works. Although operating- and maintainance instructions are supplied by the manufacturers with each unit it will be tried to deseribe and explain here in a simple way and clear how to handle a tractor an engine a Disc harrow or no matter of what

an implement is concerned to achieve utmost duration of the material.

Under the definition "Maintenance" a logical order is to follow and therefore the explanations are covering:

Pre-delivery-Service, Running-in directions,

Daily and weekly attendance by the operator,

After Sales-Service and periodical Inspections by mechanicians either in the workshop on the field or at the farm and finally measures of maintenance at the end of an operating period or a year respectively.

For the closer selection the following machines and implements have been chosen: Wheeltractors including hydraulic lifts, stationary engines for irrigation pump-drive, mouldboard- and disc-ploughs, disc-harrows, row-crop cultivators, tool carriers, grain drills and planters fertilizer-distributors, mowers, combines and trailers.

In addition equipment for 3-point linkage, power take off drive and hydraulic-actuated units are classified separately.

1.) <u>Pre-delivery-service</u>

A good preparation of a machine before the first "putting into operation" is allready an important part of maintenance. Longlasting overseatransport, storage in harbours, influence of dust and humidity as well as rough handling resulting in rust and oxydizing of metalsurfaces, drying up of rubber parts and bearings causing damages and dirt.

Before packing and shipping most factories fill engines for example with anti corrosion oil or cover naked metal parts with rust protecting paint or complete units with spray wax.

For reason of packing offstanding parts are removed or bulky implements completely dismantled. Therefor preparation in generally includes consideration of all circumstances as above and means at first: unpacking, checking, cleaning, fitting of parts or assembling of an implement and registering. More details to make certain machines and implements "ready for use" or pointed out below.

For assembling of dismantled ploughs, harrows or multi-purpose implements mounting instructions are provided by the manufacturer such as drawings, pictures and illustrations. Also part lists are of help for. If bolts are missing for replacement only equivalent bolts in size and material must be used as it has proved frequently when a plough as an example was put into operation, bolts, just taken from a local shop without regard of quality not soon worn or out. Concerning bolts and nuts also the norms of threads have to be observed and not to mix on one implement metrical bolts and such of inch-sizes as the different hexagonal spanners may not be on hand later-on to retighten bolts and nuts.

Registration

For tractors, engines or selfpropelled machines it is advisable to fill in an index card to record type, chassis Nr. or engine Nr. delivery date, destination, standard- and optional equipment, type and serial-Nr. of important items such as dynamo starter, oil pumps fuel pumps a.s.o., for reason of spare parts supply, and other administration. One copy for the head office and another for the store. In case of a demand for spares from a remote place and the

order is not clear specified these records enease to identify the needed parts.

For correspondence with manufacturers too it is a need to record at least the serial number if special informations are asked or a settlement of claims is requested, to prevent misunderstandings as certain alterations or modifications on serial products are resulting also in changes of part numbers.

Registration means further to record any occurrence concerning a vehicle or engine and to attach letters, reports and other notes continually to the index card for getting a particular file.

As an example in Pakistan: tractors of a certain type were equiped with either a German made or an Austrian made fuel pump. As injection pump parts were of need at Lahore and ordered only by name the central store in Karachi by ignorance of the engines specification actually sent the wrong parts and more than a week was lost until the correct spare parts arrived.

a) **Tractors**

The tractor as the most substantial organ in the chain of machinery for mechanisation of agriculture has to be given the most attention regarding maintenance.

On preparation to make a brand new tractor ready for use and to avoid troubles at the beginning it is advised to take after removing of packing materials, fitting of dismantled parts and cleaning the subsequent steps:

Batteries, dry charged, to be filled with the electrolyte at a specific gravity of 1,23 kg/l for tropics. Only 20 minutes later a new battery may be put into service and at the latest 12 hours after fitting a several-hour run of the engine must be undertaken to charge the battery fully by means of the dynamo.
Under no circumstances should a new battery be charged by a rapid-charger. After proper connection of both wires the terminals inclusive the thread of clamp-screws must be greased for which acid-free grease shall be used only. Threads of fixing screws for the battery itself closed to battery-terminals shall be greased eqally to prevent oxydizing.

Engine-Oil should not be checked only but changed if anticorrosion-oil was filled at the factory. When changing oil the oilfilter must be drained too in order to avoid mixture of different oils. Usually engine manufacturers allow to run enginges uncharged up to 10 service-hours with these protection oils but as a fact serious engine troubles ocurred when these limits exceeded. It is not worthy to save costs for an immediate oilchange if for instance a farmer to whom a tractor is delivered gets the information to change oil within 10 service-hours and the driver later-on continues to operate or has no oil available on time and zylinder liners crankshaft and bearings get worn prematurely.

Air-cleaners are of greatest importance particularly in dry areas. Oilbath-airfilters usually are empty ex factory

and pure engine-oil has to be filled up to the level-mark. Used oil must never be filled in aircleaners.
On Dry-type steel-wool prefilters some oil is to be put on to encrease filter efficiency whereas plastic cups as dust-separator of cyclon-type-prefilters shall not be filled with oil in order to make the separation of dust visible. Although the engine is brand new it is a must to tighten all hose-clamps and pipe-connections between filter and engine. The best filter does not protect pistons and liners if behind it quantities of dust are sucted in.
Cooling-system: For tractors with water-cooled engine it is indispensable to fill the radiator on the spot before starting the engine. For reason of indolence, instead of carrying water to the tractor it is often preferred to start the engine and drive to the next water-take-off to fill the radiator there. Such careless handling can lead to overheating of engineparts resulting in costly repairs. A cooling system is to fill slowly to enable the air to escape completely. The radiator shall not be filled till the upper board. Expansion space after heating up of water should be preserved. Water hoses are to be checked for cracks and hose-clamps tightened. Thermostats must not be removed unless the engine manufacturer has agreed with.

Fuel-system: On agricultural tractors today chiefly Diesel-engines are used. Arriving from factory with empty tank rests of fuel remain in filters, pipes and pump. In case of long transportways and storing these rests of old Diesel-fuel should be washed out and the fuel system

rinsed by fresh fuel entirely. This means filling up the tank than loosen the bleeding screws on filters first, and to bleed the filters either by means of a hand supply-pump or by own gravity of fuel, until pure fuel only is flowing out. Subsequently the pump itself is to be washed out in the same way. Fuel filters provided with a drain screw or a plug at the bottom should be drained to remove condensed water and sediments.

Lubrication of pump and governor must be observed and tank cap checked to make sure that the breather hole is free. It often happened that this air passage was closed by paint or dirt and vacuum later disturbed fuel supply to the pump.

Engine test-run: Before starting a new engine should be turned by hand a few turns to make sure that everything is moving easily. A new engine type not yet known should be started under observation of operating instruction. In any case after ignition a new engine must not be accelerated immediately to high revolutions. Oilpressure-indication is to be watched instantly at starting and the battery-charging lamp as soon as the engine is running. Warming up the engine at medium revolutions a general check-up for leakages of oil or water, is self-evident.

A particular examination of the thermostat on a water-cooled engine is recommended, as it ocurred indeed that even a new thermostat valve got stick when the cooling-system was empty and dry over a long period resulting later in overheating of engine. To examine function of thermostat simply warm up engine to about 75-80°C and

water-circulation- must be seen in the radiator. When cooling down below 70°C and watercirculation stops the thermostat-valve proves to be closed again.

Tires: Exact tire pressure is indispensable and as a rule tractor rear tires are to be inflated at 0,8-1 Atm for field work respectively 1,5 Atm if mainly used on the road. Front tires usually run at a pressure of 2,5 Atm. If tractor is operating with front loader tire pressure shall be increased to 3 Atm. The temperature in the country is of great influence for tire pressure. Tractor tires inflated normally in Europe arrive for instance at Jeddah, Saudi Arabia where temperature in the hot season raises up to 45°C or more whereby tires get tight nearly to burst. So it is a must not only to inflate tires found at low pressure but also to reduce and correct pressure if tires are too tight.
It is an atvantage to mark the required pressure by paint on a spot near to the wheel or the tire-valve concerned in order to remember further-on the operator in charge for maintenance.

Examination of the complete vehicle

After the above inspections a short drive on the road is necessary for examination of clutch, steering and brakes provided full lubrication service was carried out previously too. It is to pay attention particularly to bearing-bushes for pedals and shafts actuating the clutch and brakes, furthermore to all operating levers and last not last all pins connecting tie-rods of the brake-system,

differential lock, accelerator and clutch. Those points are suffering frequently from sea water on the way or from humidity during storage and getting tight by rust. Immediate treatment of these parts with "penetration oil" is the only solution to keep them free moving.
As an example, tractors shipped to Khorramshahr in the persian gulf and only two month later transported to Shiraz, delayed for unexpected reasons, it is quite obvious that workshop people in charge of "pre-delivery-service" must feel obliged and responsible there to look also after such insignificant parts.
With examination finally of lights, power take off. Beltpully and hydraulic lift the traktor is considered to be ready for use.

b) <u>Stationary engines</u>

As the preparation for use of a stationary Diesel-engine driving a pump a generator or compressor, is identical with the measures for a tractor-engine, only special precautions are pointed out here regarding installation and fitting.
The engine must be exactly horizontal, well tight to the fundament and correctly aligned with the machine connected to. Enough ventilation for cooling system and air-intake must be given if the engine or the stationary unit respectively is working inside a station-room. This means a room sufficient in size and adequate space between engine and walls. Walls provided with windows for additional air-ventilation in the hot season.

Attention is to be paid also to the exhaust line.
No sharp bents of the pipe immediately after its connection to the engine to avoid heat-stow harming cylinder heads by overheating. Exhaust temperature should be kept off the air filter too as the temperatur of air sucted into the engine is of influence to the engine-output. As a rule pro raise of airtemperature by 3°C engine power is reduced about 1 %. The real output depend also on atmospherical conditions and 1 % difference per 100 m Altitude has to be taken into consideration. A 50 HP engine at 1000 m above sealevel gives actually 45 HP only.
Unsufficient operating temperature of a Diesel-engine is as bad as overheating. In case of a cooling system based on fresh-water-stream or actuating by surface-cooling of the water in a separate tank, factories instrucitons regarding water-quantity have to be observed accordingly otherwise an early wear and tear will occur.
For example a pump-set was put in a well near Aleppo in Syria about 10 meters deep to bring up water for irrigation. The engine without radiator was connected for cooling direotly with the water of this well. Cold water uncontrolled by a valve was pumped continuously trough and after 200 service-hours cylinder liners piston rings and other parts were completely worn out resulting in a costly engine-overhaul.
The To run an engine-station at a remote place without guarding personnel it is a need to provide the engine with an automatic stop device which works electro magnetical and

stops the engine instantly in an emergency case when operating temperature is exceeding limit or oilpressure fails

c) Ploughs and harrows

Preparation for use of a new mouldboard plough or a disc plough first of all needs to assemble the implement right according to drawings or under comparison with a sample. All bolts to be tightened fast in order to obtain solidity required for these heavy-duty implements. The shares or discs should be brought in right position at once so that only little corrections are necessary later on by the operator. That means to put the pull rod or the linking axle of the plough in a position that, when the impliment is attached to the tractor, the first plough-share or disc is cutting the soil by its entire working width besside of the right tractor rear wheel running in the furrow. Another important preparation work concerns the surfaces of mould boards or discs. They are usually covered with rustprotection paint thus giving a rough surface what causes sticking-on of soil particularly if humid. Only polished tools are doing a proper work whereas Sticky-ones use to jam and not to turn and crumble the soil as fine as wanted. By means of thinner and sand-paper should therefore those parts be cleaned carefully as this sticking-on of soil also requires more traction power resulting in tire slip and higher consumption figures. Mouldboard-ploughs should absolutely be supplied with a spare share for each body as mostly no possibility is found

at remote farms or villages for sharpening of stump cutting tools. Regarding specification of mouldboard ploughs for regions where the ground is hard an stony it is preferable to order bodies equiped with adjustable chisels. Reversible Disc ploughs should be checked for easy-going of the reversing mechanism and all gliding parts greased sufficiently.

For preparation of new disc harrows assembling according to the design and tightening of bolts are the basis precautions. Than linking on a tractor in order to prove the function of single-adjustment for the disc gangs.

d) Drills, planters

To continue in the sequence of farming operations a new drill or planter before overhauling for work should be checked particularly for easy-moving of all rotating and sliding parts of the drive and the control device for seeding or planting rates and other adjusting equipment.

Although greased probably at the factory, to assure its performance the implement is to be lubricated on those points by actuating simultaneously the wheels and levers in connection with.

On a grain drill for example the function of gear drive or chaine drive for seed drop is easy examined by moving the implement a few meters onward on its

wheels actuating the machines mechanism. Than to shift the different operating levers several times in order to free the sliding parts from paint and make them easy-going by lubrication.

Fitting of optional equipment like irrigating shovels or covering knives etc. and carrying out adjustments it's the best to do it right away and not to leave this job for the operator later on.

e) Row-crop-cultivators, tool carriers

To make such implements ready for work the row spaces desire in the aerea of destination or the type of row-crop tractor to be used with should be known. Without mentioning here the variety of equipment the row units should be adapted and fixed at the workshop already in its right positions on the implements main frame or tool bar respectively under observation of wheel track the hitch-on points and the equal distances from one unit to the next one. Unless tractors are in use with adjustable tra ck the row distances are given by dividing one of the two standard wheel tracks of either 1,25 m or 1,5 m resulting in 42, 50, 62,5 or 75 cm of space between rows.

It is a kind of maintenance already to overhand these implements completed as + f. e. unexperienced operators would face enough difficulties in doing this job by themselves and there is still the final adjustment of

shovels, discs, shields, sweeps or hoes to be done for following the rows at the practical work with accuracy.

f) Mowers

Whether mounted mowers, rear or lateral on a tractor or trailing movers, there are some features to be observed. The knife assembly, the PTO-mover drive and the attachment to the tractor. Once again on preparation rust-protecting paint must be washed away from knifeblades and fingers, by means of thinner or petrol. Then knife sections, guiding pieces and hold-down clips oiled substantially. When examinating first on idling speed lubrication of knifesections should be continued for a while before accelerating gradually. Not to increase the number of cycles immediately up to the maximum speed but keep the mover-drive running for a few minutes at a medium speed, as a kind of a running-in measure. At stop position the cutter bar can be checked for equal temperature of all points where the knife-bar is guided and in case of abnormal heating the respective holddown clips or the knife guide plate must be readjusted.

A safety-release, if any, should be tried once for its function to ensure against breaks of drive parts or knives when the cutter bar gets jammed under bad mowing conditions. Usually manufacturer's technical data show a certain torque in mkg to release the safety clutch but in the practize this force can hardly be measured if now test device is available. As a rule it is sufficient to simply put a lath of softwood approximately 2 cm thick between knives and

mower fingers at full speed. At this ordinary test by the resistance of the wooden piece the mower drive must be interrupted by slipping of the safety relaise. A side - or rear-mounted mower is connected to the tractor hydraulic lift to bring it down to working position and to lift it up for driving by means of the 3-point hitch or a remote cylinder. In any case is the adjustment of an automatic cut-out to be examined. When lifting up the mower in action the PTO-drive must get disengaged as soon as the cutter bar reaches an inclination limit indicated in the operating instruction booklet. Particularly on mowers which are shipped separately and mountet only on the spot this cut-out device has to be regulated accordingly to prevent damage of drive rod or other parts linking the knife-bar in case the mower drive continues running at a steep angle of the lifted cutter bar.

g) Combines

The pre-delivery-service of such a harvesting machine without any difference of kind or type, self-propelled, power take off-or engine-driven includes some preparation measures similar to those already described for tractors and mowers.

To deal with a combine it needs more experience and usually if a new model appears on the market the factory delegates a technician for training of people and for demonstrations. So it is supposed that the basic knowledge was obtained by the mechanicians in charge with completing

preparing and with a first trial-run of a new combine.
If the engine on a selfpropelled or engine-driven machine is then ready for start and all other important components like Brakes, clutch, steering, tires and the cutter bar have been inspected the completed unit should be tested on a stationary run by engaging carefully and slowly the moving elements for cutting, heading, elevating threshing and separating at a medium speed.
Although a combine has been tested and checked before leaving the factory this stationary run is worth while and necessary too to eliminate eventual defects such as abnormal vibrations, noises temperatures of bearings caused by transport damage, seawater or dust.
General greasing according to the lubrication chard is a must before accelerating the engine up to normal working speed. A power take off - driven combine must be adapted to a tractor and a test run carried tnrough in the same way.

h) Trailers

As today normal trailers for road transport or wagons for farm-needs are already produced or partially assembled by local firms what caracterizes one of the first step to a gradual industrialization, there are only a few points to talk about preparation for service.
The tires to be inflatet to the required pressure and the same to be written with paint on a suitable spot.
The brakes should be examined like on any other vehicle whereby a heavy unit furnished with air brake system

should be coupled with the tractor already selected for to make a brake test.

At this occasion also the rear lights and dimmer lamps on the trailer are to be checked.

A dumper should be connected for examination with its pressure hose to the tractor hydraulic and actuated several times to prove function of hydraulic jack and to see whether the quick-coupling of the hydraulic hose fits accurately and safe without leaking of oil.

8) 3-point attachment

Tractor mounted implements are designed to suit to one of the standard sizes for three-point hitch whereby in the main category I and category II come into question. For universal use many implements have both hitch-on points for the lower links available either fixed at a distance of 683 mm according to category I and 825 mm for cat.II. with the respective pin-diameters, or adjustable for the two measurements.

Some tractors on the contrary are fitted with lower hitch links convertible from cat. I to cat.II distance or vice versa.

So it is very important when preparing an implement for mounting to bring the 3-point linkage on implement and tractor to the corresponding sizes.

It happened many times that for instance a 30 HP tractor with a wheel track of 1250 mm carried a cultivator with the lower linking pins set at cat. II position of 825 mm.

Thus resulting in too little space between draw side-bars and rear wheels harming the tires. As another example, a heavier tractor furnished with 3-point hitch, category II working with a plough smaller in size due tu high resistance of soil. The axle head pins and the upper pin on the plough are of small cat. I diameter and do not suit to the holes of the ball joints on the three tractor links. An excessive clearance in particular on the upper link point does not permit precise ploughing at constant depht as quick response of the draft control is disturbed. To compensate such clearance spacer bushes usually supplied with tractor accessories shall be put on. Another essential part of preparation work for 3-point attachment is the checking of adjusting devices. By turning of the various cranks and turnbuckles and lubricating threads and bearings it is to make sure that the implement can be adjusted easily for level position, for working depht, working width and for alignment with the tractor.

j) <u>Power take off drive</u>

PTO-driven machines and implements ranging from light speaders, hay-making units, ~~over~~ rotavators, pickup presses upto heavy machines like crop choppers, corn pickers and combines are mainly operated at a 540 RPM standard revalution of the PTO-shaft. This PTO-speed can be controlled by the tractor driver under observation of the RPM-counter on the instrument board and the drive can be interrupted if necessary by actuating the clutchpedal.

On preparation of a PTO-driven machine it is recommended first to do a few turns by hand before powering it by the tractor in order to prove free-running of all movable parts. Turning by hand as far as light machines are concerned. For heavy units it needs of course the engine-powered PTO-drive but under slow engaging of clutch, ready to release again in case if anything is wrong endangering the machine.

After this primary examination it can be proceeded with the test run under gradual raising of speed up to the 540 RPM similar to the stationary prove pointed out formerly for combines. There is more to say about PTO as certain working conditions for harvesting machines require a "life-PTO" or a totally independent PTO. Life-PTO means a two-stage clutch on the tractor. On driving with the PTO engaged the transmission aliona can be disengaged by releasing the first stage only. The tractor stops while the machine continues working. Only when the second stage of the clutch is released the PTO-drive is interrupted too. The examination of double clutch is part of tractor-checking for service. For a fully independend PTO there are no special measures to undertake. Just for explanation the PTO shaft is directly connectet to the engine and continuously. powered via a separate clutch which permits engaging and releasing of the driven machine even under full load. For reasons of safety propeller shafts for driving of agricultural machines are furnished with a protection tube and protection shields on both ends.

In order to preserve accidents it is indispensable to provide for a proper fixation of the propellershaft protection on the tra ctor rear end before handing over the unit for operation.

k) Hydraulics

Hydraulic equipments already mounted and installed at the factory need just a short examination by actuating the remote cylinders several times. At this occasion piston seals can be freed from dust by use of air pressure.
Each cylinder shall be actuated for an instant until stop to put the whole system once under maximum pressure, limited by a release valve in the control unit.
Pipe fittings, hoses and cylinder seals are to be seen for tightness.
If hydraulic equipment was shipped loose and has to be mounted on the spot the following precautions are necessary: To clean threads of pipe-fittings. If pipes were not pluged they have to be washed through with petrol.
To straight or form pipes to enable connecting and clamping without force.
To fit high-pressure hoses with sufficient clearance to avoid touching on sharp edges.
To fill pure hydraulic oil only by use of clean containers and a clean funnel.
To tighten the pipe fittings one by one correctly and with suitable spanners.
When finally testing at full oil pressure keep people away from lifted implements to exclude an accident in case

of a hose-burst or another sudden oil leak-out.
To work on hydraulics is quite delicate and must be done with utmost cleannes, Pumps and control valves are of high precision and the smallest particles of dirt, paint or sand entering the oil circuit,may cause that a valve gets stick or the very expensive pump gets damaged.
The hydraulic power lift as a part of the tractor do not need special attention prior to overhanding for work except if intended to connect remote controlled hydraulics of implements formerly used with tractors of other makes.
There are different systems of hydraulic oil circulation. Oil supplied either from the gearbox by an incorparated pump in the transmission case or taken from an own housing containing the hydraulic oil and circulating same by an engine-driven pump.
It is not advisable do use tractors with these different hydraulic oils by turns with the same remote controlled implement to avoid oil mixture.
In Lebanon at a village for example, a single-axle dumper-trailer was used by turns with different makes of tractors. Once it was noticed by two owners that the lifting power of their tractor hydraulics was decreasing gradually and it was found out that a third tractor in this community operated the dumper by the other kind of hydraulic oil supplied from the transmission case and probably not sufficiently filtered. The oil pumps of the two tractors had to be replaced at about 600 service hours because of extrem wear due to mixture of oils.

2.) Running - in Directions

With overhanding of new machines the operating personnel takes the responsibility in following certain instructions given by the manufacturers in the interest of a long and troublefree function.

Running-in concernes in the first place engines as the heart of tractors, stationary groups or selfpropelled machines. Although fast moving engine parts like pistons, rings, sleeves, bearings and valve-guides are machined with top precision and well lubricated on operation they need a certain time to obtain the final polish and adaptation. This smoothing of surfaces to reduce friction and to obtain the maximum performance of the engine must take place at a diminished speed of those sliding parts and at reduced charge. Therefore no full throttle during the first 30 service hours and no full load up to 100 hours.

First oil change at 30 hours and the second oil-change inclusive filter replacement at 100 service hours.

To talk about directions for running-in it means not only having them printed in the operating manual but it is the task of the person in charge for delivering of a new machine to give full explanation to the operator personnally.

It happened very often that these explanations were given to a person who fetched a new tractor and the next day at the farm a native driver was ordered to start working and knew nothing about.

If complaints arise that for instance among two or three

tractors of same type, one of them is pulling less under equal conditions, than is reason to believe this engine was overloaded from the beginning.

As a conclusion to those terms of maintenance "Running-in" directions should be made visible to remind the operator. A touch of paint on the RPM-meter to mark the limit of engine revolutions.

A label sticked-on near the instruments watched by the operator or a chard well fixed in front of the driver with short instructions printed in language of the country.

Beside of usual running-in measures such as reduction of load and speeds, early oil and filter change, no quick acceleration of cold engine some Diesel-engines are provided with a sealed stop on the injection pump.

This stop sealed with lead controls a reduced fuel injection and has to be removed at the end of the running-in time.

The removal of this seal should be mentioned in the information print but left for the machanician carrying out the first inspection. Drivers must not touch fuel pumps.

Running-in of tractors and other mobile units is extended farther to an early oil change on gearboxes, transmission-cases and hydraulics at about 150 service hours, conform to factories instructions.

3.) <u>Daily and weekly attendance by the operator.</u>

It is not only a question of training and education to make a tractor driver or an operator looking after his machine regularly and with necessary attention. He must be given at first the facilities and the time for. Particularly on

overhanding a new type of tractor the driver must be shown how to operate for starting and driving, how to attach implements to the 3-point hitch and to the PTO.
A short demonstration on the field is the best way to show plough adjustment.
An assumption for regular attendance is the knowledge about the machine to be maintained so it is to show and to demonstrate airfilter cleaning, oil check on engine and fuel pump inclusive governor, oil change, filter change, lubrication, radiator check, V-belt tightening battery and tire service.
A further important part of these explanations concern filling of fuel carefully, cleaning of fuel filters, bleeding of filters and pump and last not least the use of those tools and accessories supplied with the machine to go around with, once a week and tighten all bolts and nuts.
In generally drivers are more acquainted with a tractor than with implements and farming machines. Therefore more time should be spent as usual to show really all lubrication points on a combine or a straw press and to demonstrate how to adjust drive belts or roller chains for right tension.
Not to forget to indicate how interior sections shall be cleaned.
If the driver or operator has unterstood how to do and what to do and he is willing to carry on with his obligations the daily and weekly attendance still depend on the facilities he is given and the time left for.
To improve gradually standard of maintenance it is not enough

only to train operating personnel but also to influence owners or holders of machines to take care for a proper place at the farm, for lubricants, filter replacement, cardridges, and cleaning materials.

If a farmer is running a machine by himself he is convinced sooner that certain amounts of money have to be spent for maintenance and that half an hours every day must be spared for looking around the tractor and implements or machines and he will provide for sufficient time once a week for washing, greasing, airfilter cleaning and to tighten bolts and nuts.

Regarding daily and weekly services to be carried out by driver or operator some essential details are now pointed out according to experience with engines of tractors and combines.

Engine-oil to be checked with the tractor in level and prior to starting. Filling up just to the max.mark on dipstick and not higher. Oil consumption if complained was often caused by exceeding of engine oil level.

Aircleaners, pure engine oil to be filled only in oilbath filters and no used oil, kept after engine oil change.

At least once a week filter inserts to be taken out and aircleanner entirely washed out inclusive central suction tube. Washing airfilters with Diesel fuel only. No petrol or Kerosin as engines were damaged seriously when speeding up to highest revolutions by sucting in of petrol uncontrollable.

Combines working in clouds of dust need additional aircleaning. A dense cloth fixed around the pre-cleaner helps filtering.

Radiators when draining water every day for reason of frost not to renew it by fresh water each time but to keep content and use it again to diminish scale. There are regions where water freezes in winter time. In Azerbeidjan for example occured difficulties on repairs of tractor engines. Cylinder liners were almost grown together with the engine housing by scale after daily change of water and only by destruction itwas possible to remove the liners for replacement.

Outer cleaning of radiator is of equal importance as washing inside, Blowing through from both side by use of air pressure to remove dust, straw and leaves.

On combines and tractors during harvest season engine temperatures can be normalized by this way.

Fuelfilters, over-zealous drivers are washing through filter elements every week. This is dangerous because they get pervious. Particles of dirt are passing easier to the pump. For filter service it is recommended to drain once a day condensed water and sediments if a drain plug is available and to watch transparent pre-filter cup on the supply-pump. Main filters to open only if prefilter shows much dirt and water. Replacement of filterelements conform to factories instructions in an average every 500 service hours.

Electrics, wires getting loose frequently on dynamo contacts causing short circuit endangering voltage regulator and dynamo. Wiring therefore to be inspected once a week and contacts tightened.

Battery cells to be refilled with distilled water until cell-plates are covered. At this occasion the terminals can

be checked for oxydation and acid-free grease put on.
To free battery terminals from oxydation hot water is best to take for.
So far as vehicle engines are to be maintained by operating personnel, stationary units are handled similarly.
For implements in generally is to say tightening of bolts, lubrication of movable elements and sharpening of stump cutting tools are duties of the operator during the season for a certain implement.
In particular plough shares to be sharpened or replaced by sharp ones. Mover knife blades to be ground if grinding machine is on hand, otherwise a new or reconditioned knife-set to be fixed.
One problem remains. It's the change of personnel. If a driver quits or an operator is fired, very seldom he will transmit his experiences to a follower and these important daily and weekly works will be neglected unless the farmer or administrator is able to make the new man used to the job within a short time.
In developing countries operating personnel for agricultural machines changes more frequently and quick as people are not so established and settled. Therefore periodical inspections in extension of "After-sales-Service" will also serve for repeating explanation to operators and drivers.

4.) <u>After-Sales Service</u>

Parallel to maintaining of machines by the operators the workshops representing those machines are obliged by the manufacturers to carry out one or two inspections during the running-in period.

This is by a great deal theory and only realizable on machines operating near the town or the workshop in question. As "After-Sales Service" should be left exclusively to the authorized workshops and a tractor 80 miles or more away will hardly be driven to town for checking, so a service-car has to be sent out for.

But considering travelling expenses a service-car is practically not sent to a distant place for inspection of a single machine only.

"After-Sale Service" on such units is therefore mainly scheduled for a round-trip in that area, what means no quaranty can be given for well-timed inspections at, for example, 30 and 100 - 150 service hours. For these reasons such a high value is set on "Pre-Delivery Service" as described under paragraph 1./ in order to assist for trouble-free running until the first inspection, even if delayed.

The manufacturers insist on execution of certain works like tighten of cylinderhead bolts, adjusting of valves, check of injection nozzles, first filter service and oil change tighten of V-belts, adjustment of brakes and clutches after a prime wear and tear.

The works are listed in a service-booklet or in a similar paper overhanded with the machine and this paper can be an important contribution to the improvement of service.

One or two inspections according to agreement, should be free of charge for the customer. But a dealer is not always ready to spend money for these services.

By way of a clever sales policy the expenses for after-sales inspections are already covered by the sales price for a machine. The dealer receives credit-note for a fix amount only if the inspection work was carried out and confirmed by the customer with signature on a copy of the beforementioned paper.

This system animates a lot for real after-sales service,. If it is paid for, a dealer will not so much hesitate, he will order to do the inspections.

The costs will be credited to him by the Central Sales Office after receipt of that signed copy and the customer is satisfied too.

After-sales service finally means more than adjusting of valves or brakes on a tractor and to replace a ballbearing on a pick up press. It is an opportunity to repeat all operating instructions under practical working conditions and to talk with the operater and owner when they got some experiences meanwhile.

It allowes furthermore to get impressions about specific operating conditions in an area to decide definitely specifications of implements or tractors in regard of further sales. By factory's advise i.e. a three-bottom plough was sold with a 50 HP tractor but by reason of hard soil the third bottom had to be removed on the spot. No use to continue selling of same units in that region.

Defects on machines or implements can be registerd to report them to the manufacturers or to undertake preventive measures right away.

To visit farms on after-sales service well equipped 4-wheel drive cars should be chosen for to reach the tractor or the combine what is mostly a cross-country drive and to meet finally with all requirements it needs qualified and reliable men, with some knowledge about agriculture.

A service man beside of his occupation must be capable also to operate and adjust farming machines. Not only to do repairs but to find the causes for defects and give clear reports in case of faulty materials or workmanship. He must know how to deal with farmers and drivers.

If defects on machines result from incorrect handling it is his duty to prove it and to indicate the right use, not by blaming only but in a way of assistance.

Manufacturers role in After-Sales Service is to delegate service representatives periodically or when new models are to be introduced. Although this activity is chiefly based on the interest of business increase those technicians do not remain only in the office or workshop but join service men also for round trips. On these occasions the best chance is given for a service man to obtain more experience for his job and it is finally a task of the local service - management to make use of a service-engineer's presence for the benefit of the whole development program.

5.) <u>Periodical inspections by mechanicians.</u>

In continuation of the After-Sales Service works a tractor or any other powered unit need to be checked from time to time and maintained accordingly to extend their life-duration.

But the problem starts as soon as free-service is over. The farmer does not like to call for service if he has to pay and a dealer will refuse to give order if the work is not being paid.

There are two ways to solve the problem arising mainly with machines which are working far away. First,as a compromis to look after those units occasionnally on a service-trip scheduled for obligatory "After-Sales Service" on machines recently sold in that area. This is of course not a periodical inspection but it serves for maintenance anyhow. The customer will apreciate it and certainly agree with payment for labor costs. Travelling expenses on the other side can be compensated partially by selling of normal-wear spareparts like filter elements, V-belts, bulbs, gaskets or plough shares and cultivator tines taken along with the service car.

The second solution is a long-term obligatory service like in IRAN based on a credit system supporting sales of agricultural machinery as described under paragraph A/ Twice a year a dealer was obliged to grant maintenance service for tractors as well as for the implements, over a period of three years. And he was forced to do it in order to get the instalments paid in due time. This system was hard for dealers and their workshops because of costly journeys combined with considerable wear-out of service cars but it proved appropriate to the requirements and the expenses were covered by a great deal as spareparts could be sold and some repairs were carried out on charge too.

Machines near at hand for an official workshop are easier to control and one of the advantages for those units is the stock of genuine spare parts at the dealers place.
It becomes more difficult with the others out of regular control as people there must rely on improvised maintenance and repairworks on the part of local workshops mostly primitive equipped and where original spare parts are hardly on hand.
The assistance given by these local workshops is not always satisfactory but a farmer has to contact them if he is in need.

In the way to improve conditions for maintenance it is therefore not right to blame such a workshop if f.e. a hydraulic valve was wrong fitted and operating worse than before.

It better should be tried to get these workshop people familiar to the working methods on the machines in question and ready to cooperate.
In fact it has proved successful when on a service-trip, beside of the official workshops a visit was paid also to others and leaving some informations there.
These people were grateful a d the quality of work improved and a further increase was noticed when a commission on spare parts had been arranged for them.
To turn now actually to the so-called periodical inspections it is intended to concentrate on tractors as the most important machines and to point out only essential operations by short words as some works are just a repetition of pre-delivery and after-sales services. Implements are in any case verified when ever a service man comes to see a tractor at the farm.

TRACTORS

Take note of chassis Nr. and reading of hour meter. Drive on the road for a test to find out condition and function of all sections or equipments.

For engine oil change drain oilfilter too. If injection pump is connected to engine-oil circulation it must be drained as well. Oilchange interval is normally 150-200 service hours, for filter replacement 400 hours. In case of an easy-change cardridge same should be tighten by hand only. Metallic filter inserts to be washed in petrol at every oil change.

For fuelfilter-cleaning or replacement, attention, not to mistake position of rough-and fine filter insert. Only diesel fuel and no petrol for washing filter elements

Hydraulicoil, Main filter to be washed in petrol at any inspection. Oilchange once during running-in time at approx. 150 hours and than every 1200 hours. No engine start if hydraulic oil is drained to prevent pump damage when dry-running. Attention when filling oil. Utmost cleanness indispensable.

Power steering, when changing hydraulic oil frontwheels must be lifted to enable moving of steering for reason of oil draining without resistance. Also for filling the hydraulic system entirely it needs turning of steering wheel to both directions.

Gearoil-change, at operating temperature only. First oilchange at 150 servichours and subsequently every 1200 hours as a rule.

Cylinderheads, to retighten at least once at the first inspection of a new engine and in case the cylinderhead gaskets have been renewed. Tighten accurately by use of a torque wrench and with engine at working temperature. Valve clearance, to adjust with engine cooled down and by use of the right filler gauge for inlet valve and exhaust valve. Turn crankshaft by hand only and adjust both valves at the moment when piston is on compression dead center. Never adjust valves with the engine running, it is incorrect and filler gauge will be damaged. Injection nozzles, at least to be examined for correct pressure and clean-atomizing at any inspection of a tractor engine. If no nozzle-tester on hand to see pressure, nozzle holder must be removed from cylinderheads and fixed to the injection pipes outside the engine. By actuating starter, function of nozzles is visible. To work on nozzles for adjustment of pressure, dismantling for cleaning or replacement, a clean working place exact fitting spanners and a bowl of pure diesel fuel is a must. Clutch, to be checked for clearance between release bearing and clutch levers. A play on the pedal proves that clearance and the clutch operating rods and levers must be adjusted on their threads or bolts to obtain it. A return spring must put back the pedal completely to its upper position. On pushing the pedal it must touch on a stop when the clutch is released. Attention for adjustment of a double clutch. First range to shift gears and at stop-point for pedal at the end of the second range PTO-shaft must be free. If not so, lower stop position for pedal must not be

changed but adjustment of the clutch itself is to correct.

Gearbox, Rear axle, to be checked on the test drive for easy gear shift, for noises and for function of differential lock. Examination of any gear drive only at working temperature. Prove easy engagement and disengagement of differential-lock with one rear wheel liftet and with driver present in order to make function and risks of breakdowns understood. Further transmission sections to be checked are such as front wheel drive, reduction gears, on the road, and PTO-drives on a stationary run with the machine connected.

Brakes, for adjusting of wheelbrakes wheels should be lifted from ground and brake drums turned for symmetrical adjustment of brake shoes. Equal position of dual pedals to be observed, as steering assistance mainly used to the right on fieldwork, result in earlier wear of right side brake linings and more play on that pedal.

Release of brakes can also be proved easier with wheels liftet. To get brake drum-, free instantly after return of pedal is a question of lubrication of all pins and bushes on the links from pedals to brake shoes.

Handbrake is to be maintained in the same way as pins and bushes get tight by rust caused by mud, water or fertiliser chemicals.

A tin of penetration oil is one of the most important belongings to get mechanical brakes working.

Hydraulic brakes need to check brake fluid in master cylinder and tighten of pipe fittings. For reason of safety a brake test with full pressure on pedals is

obligatory to see tightness of brake lines and brake hoses in particular . If bleeding seems necessary because of extensive pedal play the brake shoes have to be adjusted first to normalize wheelbrake clearance first.

Airbrake installation on tractors only actuate trailer brakes while tractor wheelbrakes remain mechanical-operated. For farming purposes rarely in use but to be found on heavy tractors for cooperative road transports of f.e. sugar beets, water tanks etc. These units need check for lubrication of air compressor, adjusting of charge-regulating valve to 5,3 Atm. normal operating pressure, draining of condensed water from airtank and adjusting of trailer brake valve actuated by the brake pedals.

Steering, if abnormal play of steering wheel, mostly ball pins in steering linkage are worn or sometimes a ball pin loose. Wheelbearings are to be checked and adjusted if clearance. King pin bushes and bearings get worn by lack of lubrication. In case of unequal wear on front tires verification of toe-in is necessary. Accurate measuring needs an even floor and frontwheels put in straight-on position. The distance between the two rims to be measured on a level with wheel centre and the measuring points marked. Than tractor rolled to half a turn of front wheels to have the same points at the opposite side again to get correct result of measuring and the toe-in can be adjusted on the track rod.

Hydraulics, to verify for function and density by actuating all single- or double acting control valves and cylinders. If lifting power is decreased, before touching pump or valves oil level and condition of filter are again to be seen first. Never try to encrease pressure by putting washers behind a valve spring unless actual pressure can be checked by means of a hydraulic tester or at least a similar manometer. Uncontrolled raise of oil pressure mislead to overloading of pump and might cause accidents by burst of a pipe or hose.

Remaining items like radiator, aircleaners, V-belts, battery, electric equipment, tires and body parts have been repeatedly mentioned herein and their inspection is a routine work but should be carried trough with the same accuracy.

The whole service including precise adjustment of valves or bearings is in vain if for instance a fuel filter remained untouched because the driver had cleaned it a week ago. In reality he lost a small spring holding formerly the filter insert tight to its seals. Dirty fuel afterwards passed through and two months later the plunger elements in the injection pump were worn out.

These part of maintenance on mechanicians responsibility is therefore again a step towards improvement of training conditions for drivers and operators.

The inspection works must not be left for the service-man altone, the driver has to assist under his supervision. On the other side the driver will insist on having checked his implements for the tractor too. So the servicemen

ie kept busy enough and will face a lot of difficulties.

Implements

Maintenance of implements is for a serviceman on a trip rather limited to verifications, replacement of parts, lubrication and adjusting. Unless a workshop is available with welding equipment, blacksmith, press, grinding and drilling machines, he will be unable to straighten a bent drawbar, to sharpen plough shares, to grind cultivater shovels or to reinforce a frame of a multipurpose implement. He can most probably do only improvisations or he takes those parts to be welded or straightened with hie car to the next townworkshop.

Mounted ploughs, gave many problems caused by wrong adjusting. The plough has to resist entire pulling power of tractor and if not straight aligned with the tractor and not in level with ground even strong built body frames or supports were found twisted or bent by force. Three point links, in particular side bars were mostly looking worse.

Maintenance . in this regard means first to put straight all parts of 3-point hitch and demonstrate adjusting of plough.

Extrem hard and dried-up soil, sometimes concrete-like is also a heaviest burden for a plough. Maximum sodity of the whole implement must be obtained by tighten of all bolts sufficiently and sharpen of shares and chisels will help for better entering of plough at working depht desired.

Generally these inspection works on other mounted or trailed implements and machines, either PTO-driven or

impulsed by proper wheels have to be carried out analogical to the corresponding items described up to here.

For heavy equipment and for big farming machines manufacturers operating and maintainance instructions were always taken along with a service-car and also in the workshops these heavier or more complicated works were carried-on with the help of service manuals.

6.) <u>After - Season Overhaul</u>

Agricultural machines only temporary in use are sometimes real victims of negligence and this marks a field for a campaign to improve standard of service, not technically but simply by explanations.

Harvesting machines performing productive work during a season, sometimes day and night and at full load, are assigned for restoration in the following years.

In order to obtain these performances it needs to convince a farmer of the advantage to arrange for overhaul of his machine on time. That means after season when harvest income gets effective and when is no hurry. Not in a contrary way as shown with the following bad example.

<u>Combines</u>, three or four units in a workshop yard's corner at Khermanshah, again IRAN. Covered with dust, flat tires, oil leakings on engine, cutter bar bent with some fingers missing, fitters busy with dismantling, cleaning and repairing and the owners shouting with dealer because of delayed spare parts arrivals. To all this confusion forecast of rain and fight about payment for these quick overhaulworks

it finally led to heavy losses on corn due to late completion of the combines when weather had already changed.

As a conclusion regarding combines there is only one advice for an owner to give in his own interest.

Call for estimate of overhaul costs immediatly when harvest is over.

Keep money from harvest income ready and set it apart as long as it is still available.

Order complete overhaul at once.

Provide for a proper place at the farm covered and protected against sun and wind.

Put combine there on jacks with tires lifted from ground to protect the rubber tires.

Disconnect battery and cover all unpainted metall surfaces with grease.

Complete overhaul includes of course engine, chassis wheel drive, mower drive, cutter bar, knives and all movable sections from header to grain spout. Repainting and full lubrication service as well.

Once in a month to start engine for a trial-run and to keep battery alife by charging regularly and the farmer need not to fear inconveniences at the beginning of the next season.

Another example now as a contrast seen in Ethiopia.

Tractors with special trailers and loaders for transportation of sugar-cane. A fleet of about sixty units, with another 10 units in spare, during campaign permanently rolling to bring cane from large plantations in the surroundings to the sugar-factory.

After sugar-campaign only a part of this fleed needed for different purposes and the other vehicles with its equipments passing one by one the central workshop for overhaul and put ready for use again in a hangar.
By proceeding with this systematic maintenance since years break-downs were cut to a minimum during season, workshop was kept busy the whole year and tractors with about 10000 Service hours or more were still in good condition.
To mention further implements or machines also temporary in use as f.e. drills, planters or pure cultivating units like distributors of fertilizer and sprayers for anti-vermin chemicals the "After-Season Service" for such machinery is aimed in the first place to fight rust and corrosion and farmers have to be adviced for cleaning and conservation measures accordingly.

D/ Repairs of Machines and Implements

Repairs in general are aimed to achieve the same performance, stability or capacity of a machine again like it was obtained before, when new and operating up to the date of repair.
This unfortunately is much theory and in reality it was found everywhere, particularly in developing countries, that repairs were carried out not objective,incomplete or careless as stated with a few examples.
An engine, heating up after a general overhaul because of incorrect pump-timing.
A tractor just leaving a repairshop and waterpump leaking again as only ballbearings and fiber-seal were replaced and the impeller

remained with worn-out face.

Another tractor engine failed at 300 service hours after replacement of pistons and sleeves and had to be repaired once more for reason of bad conection of the suction pipe between filter and cylinderhead.

Many other examples could be stated as not only the authorized workshops for a certain make are doing repairs but by a great deal also those small local repairshops which are believed to work cheaper.

They usually charge less for a repairwork as a big and fully equipped workshop but at the end it becomes more expensive in consideration of successive breakdowns or failures of the machine caused by lack of acquaintance by lack of special tools and original parts. These ordinary repairshops are surely not less important for the country's economy and the intended industrialization than any other workman shop.

It is therefore not to blame but only to characterize some weak points actually seen in this respect in the Middle East or in Africa in order to show once more where improvements are urgently needed.

A gearbox of a tractor in repair, outside, uncovered, sand getting into ballbearings and between gears, blown by the wind.

The frontpart of tractor removed and supported by bricks, dangerous and nearly to fall over.

A workshoproom, no work-bench, an engine to be assembled on the floor, not of concrete but mud or loam, black of oils, engine parts round about and a man fitting piston rings without cleaning his hands.

Or a small boy 9 years old sitting at the entrance on the floor, grinding valves in cylinder heads but in a wrong way, the smaller exhaust valve in the larger inlet valve seat and contrary.

Another boy with his fellow-friend, both of school age poor dressed, trousers and shirts black of oil, struggeling with a metric-size bolt on a plough to get it fixed with an inch. - size nut.

Ballbearings fitted directly with hammer, injection nozzles cleaned with screw driver or a ring-nut on a pinion unscrewed and tightend with hammer and chisel.

It must be stated that of course also official workshops do not perform always satisfactory repairs. But they are at least under certain control as they are obliged and responsible by contract, having repair manuals on hand and spare parts in stock.

It is a further advantage as these people are specialized on certain models and are in touch with service-engineers coming occasionally from factories for a visit. They gain on talks about repair-problems and are better kept up to date regarding modifications or optional equipments.

So to improve quality of repairworks carried trough by those official workshops is more or less a task of the manufacturers and their representatives. They have to boost their efforts in the interest of business and in view of the competition what will also be for the benefit of the "Service-plan".

The many other repairshops, independent and not responsible for the name of a tractor or a corn-picker etc. are working in the first place with the aim to make profit.

This is quite normal and a little progress has been registerd in the past years in respect of working qualitiy by way of increasing experience and by the influence of service-activity pushed forward by dealers and their official workshops.
But to raise up working quality of these repair shops to an equivalent standard, to animate for investment to improve working facilities and to end with employment of children needs more than activity of private firms. It needs a project on governemental level to accelerate this particular section of the existing education programm.

E/ Need and Supply of Spare Parts

It has proved best to supply already with a new machine a set of normal-wear parts which will be needed in any case. Such as, filters, V-belts, gaskets, bulbs, fuses or plough shares, and safety-pins etc. It quiets the farmer and assures for the first need as f.e. on after-sales-inspections a valve-cover gasket when checking valve clearance might be destroyed or a rubber ring getting out of use by filter removal for cleaning.
From psychological point of view this assortment of parts should be already included in the sales-price for an unit as accessories and not charged extra to the purchaser. He might refuse to buy materials apart but he will accept this "first-aid kit" and consider it like a gift.
For further need spare-parts business becomes more problematic as there are today three competing runs on the market even in developing countries.
The normal traffic of parts as from manufacturer of a vehicle

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or machine via sole - distributor, dealers subdealers up to the consumer, inclusive parts produced by sub-suppliers. All prices according to general price list of vehicle - or machine - manufacturer.

On second place parts direct-imported from sub-suppliers or producers of imitations, by whole sale dealers and brought on the market with lower prices. Items like seals, bearings, elektric accessories, rubber or plastic parts, up to discs for ploughs or harrows and up to engine parts such as pistons, liners, valves and gaskets.

There are furthermore local made spare parts and accessories, yet in minority but on the move to an increase of quantity and quality, supported by the authorities/for industrial development. These parts round up the whole stock offered to the consumers and are normally beating prices for imported parts of equal design.

For the mechanization of farms itself the prevenance of spare-parts is of second significance. Main point is a continual supply at reasonable prices and with equivalent qualitiy to keep machines and implements working. To overcome difficulties regarding the three directions of parts supply is a problem for dealers to solve in a way of normal competition.

There are tractor owners who expect from the dealer having in stock every single part that belongs to the vehicle and who would never accept to buy a stop switch or a head light glass from the bazaar.

The next one wants to return a set of connecting rod bearings and is shouting as he has found that identical bearings were 20 % cheaper on sale at the shop of an agent for bearings in town.

With local made parts there are also opinions pro and contra. The one buys because he is proud of national products or prefers them for reason of price and other ones do not trust in the quality and think only materials from abroad are suitable.

To meet with the problem of price-beating accessories - and spare parts-dealers, general agents and importers of tractors and other farming machines have turned to order certain spares directly from sub-suppliers altough they are bound by agency-agreement to take them from the central stores of manufacturers.

The local production in the first stage is limited to ordinary parts and such of common need. Extended investigations are necessary prior to decision to start serial production of a part and to bring it on the market.

On the first place it must suit to several makes and types of machines and implements to guarantee sufficient quantity for economic production.

Plan, study of material and to arrange for supply of row materials.

Planning and processing of tools and auxiliar devices.

Examination of first out-put with consequent improvements of surface -quality and measurement. This are just a few points mentioned in general. An effective manufacture of spare parts depend further on the capacity of local plants their equipment for casting, punching, machining, hardening of steel, painting and packing.

The move to more local spare parts in order to increase employment and to save foreign exchange for imports is already supported in some developing countries by import restrictions.

Parts locally produced and proved are excluded from import licenzes or charged with high customs duty.
To refer to the actual need and supply of spares the use of catalogs must not be forgotten. So many mistakes and errors came up by reading catalogs or parts lists due to ignorance of modification remarks or mistaking of part numbers that f.e. machines were stopped for weeks as the first arriving parts were wrong and only the second consignment suitable.
Explanation and advising of store keepers and mechanicians in reading of spare parts catologs and keeping of stock cards is therefore a further essential point of the program for improvements according to the "Service-Plan".

F/ Workshop Equipment

The equipment in general depend on the place where the workshop is located. If next door or in the vicinity are specialized workshops for diesel-pumps, electrics, for tire service or a mechanical workshop and so on, it can be made use of them.
On a distant place there is no other way than to arrange complete equipment and installations.
It is not intended to write here a list of all tools, machines, standard and special equipment for a small or a big repair workshop but just to indicate a few items to show where repair-service was found far behind and what is to improve.

Disorder in working rooms, stores and yards.
Unclean working places, dirty workbenches covered with scrap iron, ruined vices.
No wooden boards for working below a machine fitters laying on the ground.

Dirty oil pans and tins, used oil poured out around corner, no barrels to fill with.

To fit an engine or a pump what ever is of precision it needs to work clean, clean and clean again. To wash parts with petrol or pure fuel a few cents must be spent and simply charged in the repair invoice. A workshop must provide for cleaning hands and parts to be fitted.

Metric-size spanners missing or mixed up with others of inch-size. Hexagonal bolts and nuts getting damaged by wrong spanners.

No working tables to put a gearbox above for dismantling or assembling. Although people are used to work on the floor since ever, the workpiece and tools must be lifted and away from dust and dirt.

A crane and jacks, sufficient in number are for safety reasons a must to secure heavy parts or units when handling on them.

Illumination of dark working places and an arrangement for workers to get workingdress washed regularly.

Catalogs and manuals on a proper place and the car for going on trips to do field service should permanently be kept ready for operation and not to start to repair it at the moment of need.

These are basic shortcomings seen not only in small but sometimes also in workshops which were supposed to be more advanced.

At first these subordinate-looking things have to be abolished and the workshop managements or workshop owners convinced that the expenses for improvement of working conditions will come back within short time.

Than is the next step to modernize equipment as well as administration and it should not be missed to recommend in this direction a few items for those workshops in question, such as:

Aircompressor unit for tire inflating and for cleaning purposes.

Taps and ties for metrical threads.

Bearing-outpullers of different size.

Outpuller for batterie terminal clamps.

Hydraulic handpress with a set of accessories.

A set of special tools for represented machines.

A guarded tool store, registering of overhanded and returned tools.

A nozzle tester as a must for a repair shop.

Parts store with sufficient shelves and cardex system to control turn-over.

Office with a proper place for manuals and catalogs.

Repairs by use of job-cards and calculation based on working hours.

It is obvious that only a few important points were picked out and this was aimed also to remember for some more requirements whereas the normal equipment of a workshop is supposed to be arranged by the competent management.

G/ <u>Personnel Problems</u>

Questions concerning personnel are by a great deal connected to social low or some social services in particular, but no details should be pointed out here about this complex.

To meet in this respect with the "Service-Plan" the main task is education and training of staff in action for this maintenance and repair program. Actually it was found that the local companies and small firms or workshops in majority are not doing very much by themselves to get their workers and employees systematically advanced in general knowledge and in their profession.

These people usually work steady and upright, everyone conform to his personality, they are paid and get some practical experience by working.

Only a few big firms, state-governed assembling plants or foreign managed enterprises showed some activity in teaching apprentices or training of mechanics on evening classes and courses by fully granted payments.

The meaning of systematic training is obvious as a fitter should not only adjust a clutch exactly he should also know why the noise, when shifting gears, has disappeared. He must understand what he really has changed when the engine starts again after replacement of injection-pump delivery-valves and why a factory will refuse to accept a warranty-claim if the lead seal on a pump governor or a voltage regulator has been removed.

These people should be informed too about the needs for agriculture's development in general and success will depend on the initiative taken by state authorities to boost the activity for education and training of staff as suggested below Appointment of a competent department with engagement of a group of experts.

Arrangement for these experts to visit the manufacturers plants in question, abroad, to stay there for information.

Building up or extending of training centers specially for this field with arrangements for necessary educational materials, full board accomodation, facilities for practical works on machines and implements and a piece of land for operating with these machines.

Organisation of evening classes in areas far from a training center with separate courses for employers or managers on one side and for staff on the other.

Banning of children below 14 years from workshops and provide regular school lessons for them instead.

Establishment of regular apprenticeship for all branches of three years with theoretical lessions and graduation.

Sending out qualified persons for individual instructions at far places where arrangement of collective classes is impossible.

Extra training courses for drivers and operators combined with theoretical lessons and practical maintenance works.

Special courses for certain occupation branches like, welder, turner, etc. or office clerks.

Instruction and training courses specially for certain machines as f.e. combines and other harvesting machines or for a certain wheel tipe-or caterpillar tractor-make by participation of a technician from the factory.

Sending of workshop people abroad for a special and intensified training only on base of contract obliging them to return back to the same job and without claiming wage increase.

It occured too many times a brave mechanician got chance for

a two-months stay at a tractor plant and later turned to be arrogant refusing the job he had before or has quit his workshop-place when his call for higher wage was not accepted.

It is quite clear that realisation of this project is one of the most problematic tasks and will need efforts for years to succeed. It is further known that progress in the various countries is on different stage but if an idea is followed up these personnel problems will be solved parallel with the general improvement of living - standard projected in each developing country.

H/ The Role of Manufacturers

The participation of large manufacturers of agricultural machinery and equipment in the development of agriculture in general and in particular on the project for improvement of maintenance and repairs is already out-lined in the present text to the so-called Service-Plan.

With a concluding summary it is now intended to indicate once more what such big firms in the past have undertaken in this regard and what sometimes they have failed to do.

As helpful activities have been found:

Supply of machines on extra long-term credits.

Supply of spare parts on credits.

Donation of a machine or implements to an agricultural school or a research institut.

Supply of cut-away models of an engine a pump, or transmission etc. free of charge to schools or training centers.

Sending of instruction material, cut-away pictures, instruction-drawings and manuals for workshops and vocational schools.

Distribution of technical bulletins concerning alterations and modifications on serial products of machines.
Sending of technicians periodically for service-purposes, advising of farmers, for training of workshop staff, for instruction of operating personal and also disposable for technical lectures in training centers and on agricultural schools.
Transfer of a technician with same functions but with residence in that country.
Elaboration of proposals for a first stock of spare parts.
Free training and accommodation of mechanicians at the plants.
Invitation of technical functionaries to the manufacturers place for talks concerning further development.
Elaboration of assembling projects with technical assistance and financial aid for building up and starting. Supply of semi-knocked-down units in the first stage.
Transfer of technicians to assist or supervise proceeding to further stages of assembling.
Elaboration of projects for production plants. Participation on construction and management with capital and personnel.

As deficiencies or mistakes have been noticed:

Supply of models or types of machines and implements without proceeding investigations of operating conditions in an area or in the entire country, for the right choice of kind and sizes or special equipment in correspondence with soil, climate and habits of farming.

Supply of machines or implements with optional equipment or complicatet outfits which were never used or understood to operate. Just involving higher sales price and more repair problems.

Failing to send technicians on time. What means prior to local sale of a new model or better, already for explaining "pre delivery service".

Delayed reacting with improvements, reinforcements or alterations when technical defects were reported and proved.

Acceptance of wrong spare parts orders and dispatch of useless parts ordered by error or by lack of experience, instead of corrections or inquiries in case of doubt.

Sending operating manuals, parts-catalogs and repair handbooks in original language while people were unable to read and understand them.

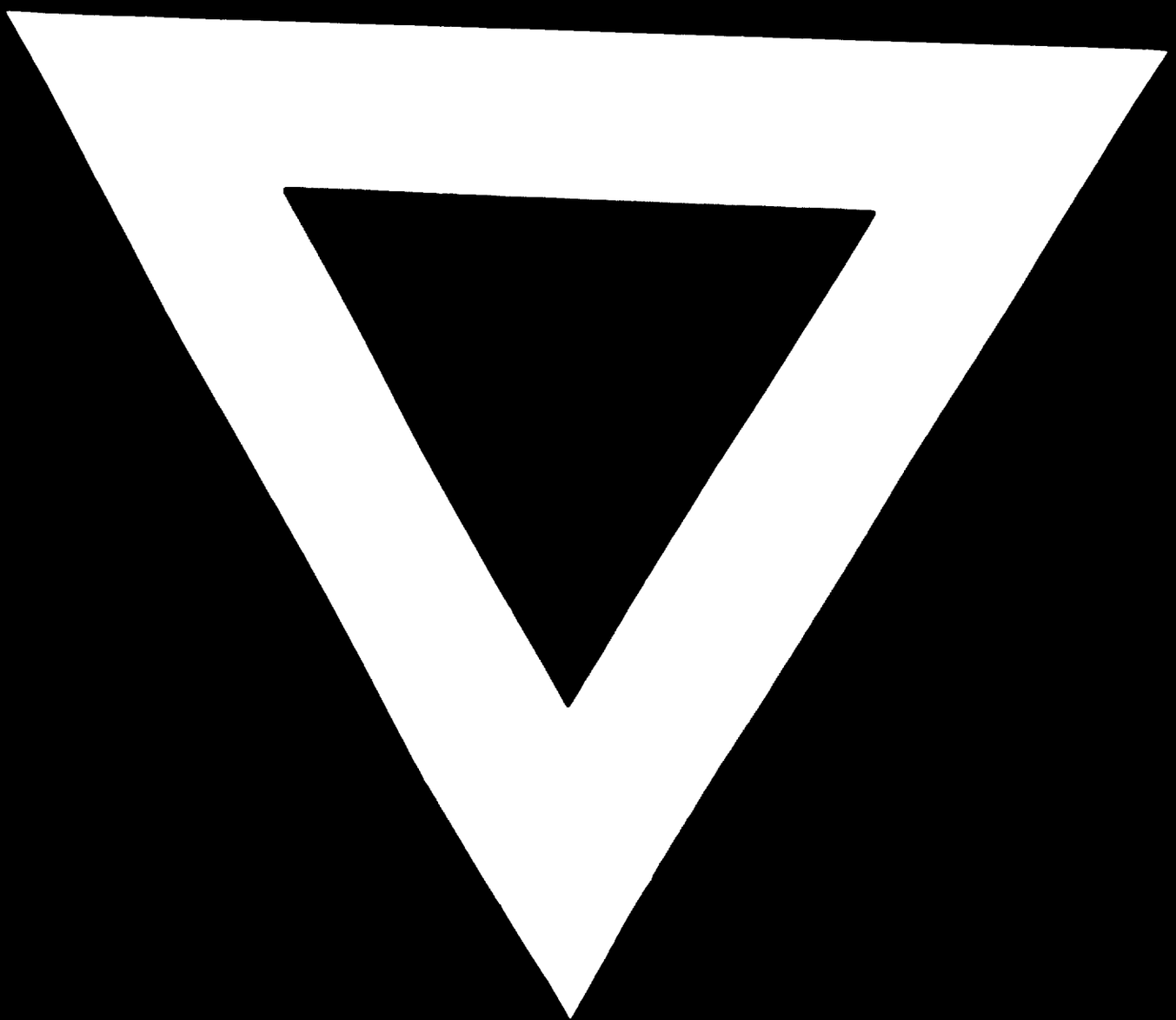
Sending those operating instructions too extensive in text instead of simple and easy-understandable prints, as people everywhere are lazy to read. These prints must absolutely be in country language.

Last not least people invited or sent to a stay at the plants for training, were given sometimes too much compliances to take liberties during regular working time, in a good meaning of hospitality, instead of keeping them under tight guidance to accomplish the training program.

Although the activity and participation of the manufacturers are based logically in the first place on the interest to stand on the market and extend business, it turns out to the benefit of this present development project.

A continuation of this assistance is automatically granted as the competition on the market will force those firms mutually to continue.

If considering that furthermore certain import rules issued by the governements oblige these manufacturers for more assistance than is their role outlined definitely and the accomplishement of the project will depend on the possibilities the governement itself is able or willing to procure in regard of funds and personnel required.



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