

The RE-BIRTH *of the*
MOTOR-OMNIBUS



INSTITUTE



AN ACCOUNT OF THE
CHISWICK
WORKS

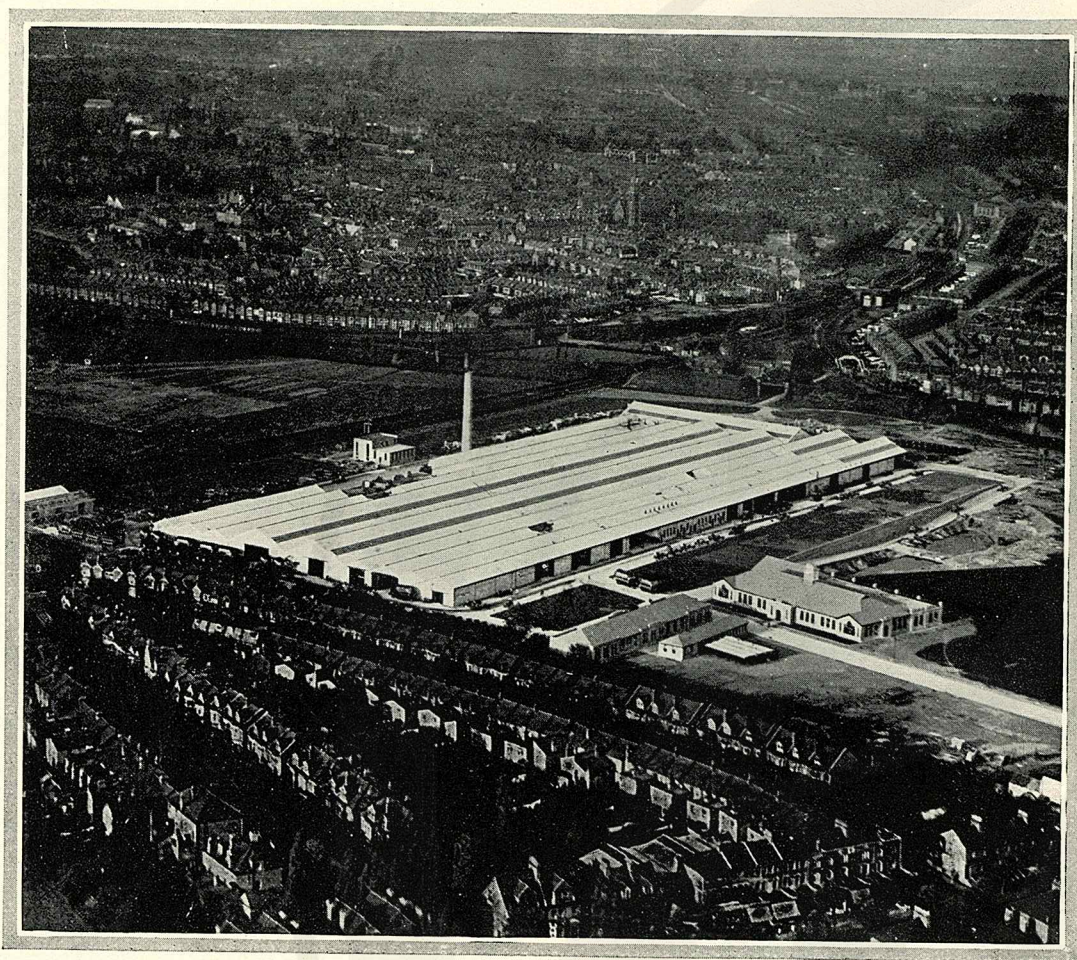
OF THE LONDON GENERAL
OMNIBUS COMPANY

WITH PHOTOGRAPHIC ILLUSTRATIONS

LONDON GENERAL OMNIBUS
COMPANY, LIMITED

1922





Aerial View of Chiswick Works.

FOREWORD

IT is only some fifteen years since the motor-bus established itself in London's streets ; and of the fifteen nearly five were years of war, in which normal industrial development stood still. The reflection adds significance to the story of the rapid growth of London's motor-bus organisation.

In the days of the horse-bus London travelled in cramped vehicles, carrying 26 passengers each, which plied upon short routes that seldom passed beyond the 4-mile zone from Charing Cross.

To-day, with a fleet of 3,000 motor-buses, of which the largest seat 54 passengers, the London General Omnibus Company carries Londoners to Guildford, to Windsor and Maidenhead, to Hemel Hempstead, to Epping, to Farningham and Westerham Hill ; in fact, to almost every important market town or village within a 30-mile radius of central London. With its allies, it covers 1,500 miles of road ; its vehicles travel more than 100 million car-miles in the year ; and its annual tale of passengers is 1,000 millions.

The pioneer motor-bus organisation of the world, it has given London a service such as no other great city possesses. It has made itself an essential part of London's life ; a distinctive and characteristic feature of the Capital of the Empire.

The opening of the Overhaul Works at Chiswick—described and illustrated in the following pages—is also the opening of a new chapter in this remarkable story. Enterprise and efficiency are the watchwords which have carried the "General" Company forward from the early days, when the broken-down motor-bus at the kerb-side was London's alternate grief and jest, to these times in which all London goes pleasure-riding twenty and thirty miles into the Home Counties. Breakdown is rare nowadays. In 1921 the lost mileage was only 3 miles in 10,000 : a percentage of .03. Enterprise, under conditions none too propitious, has erected the Chiswick Works, where the essential overhaul of this vast machinery of transport will be centralised, standardised and speeded-up to four times its former pace. Efficiency in service hitherto unattainable will be the result.

*Woodworking
Machinery and
Saw Mill.*

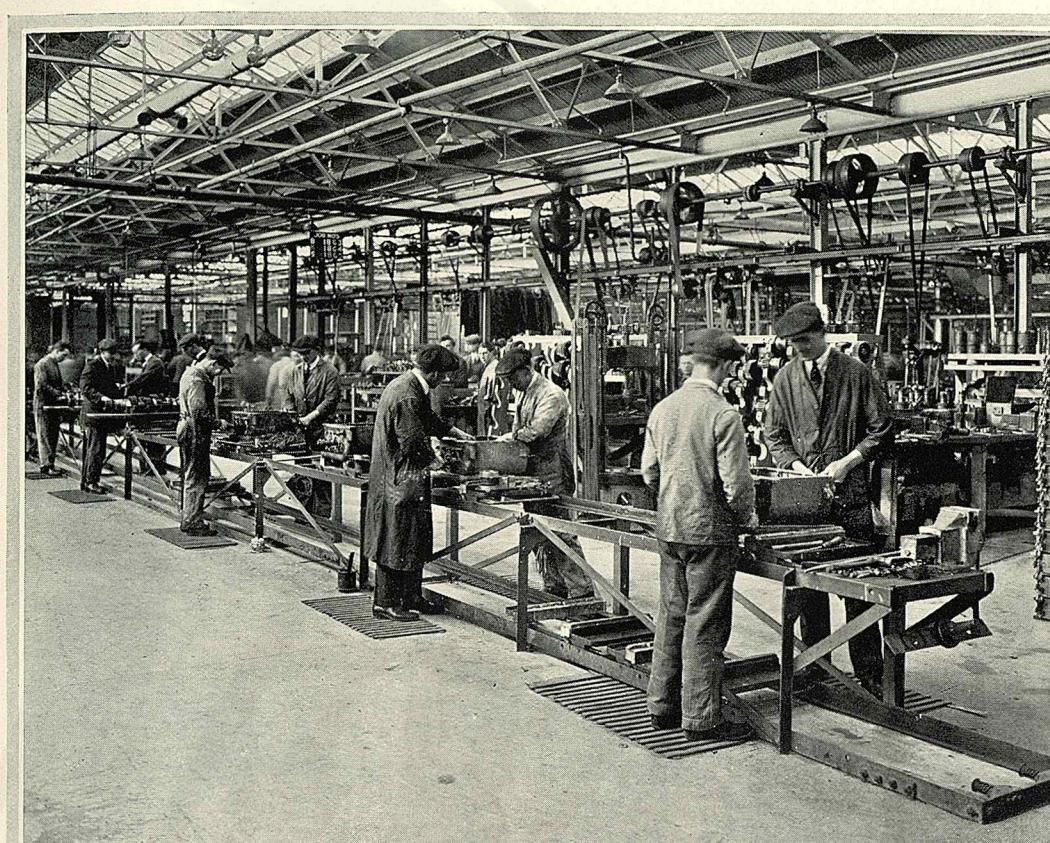


THE RE-BIRTH OF THE MOTOR-BUS

THE Chiswick factory, built for the overhaul and reconstruction of the London General Omnibus Company's motor-buses, is the most modern in lay-out and progressive in system in the world. Geographically it is located in Gunnersbury, on a site immediately facing the Chiswick High Road. Buildings and plant were constructed to plans prepared by the Company's staff.

The works extend over 31 acres of ground, of which the buildings cover more than half. Thirteen acres are actually under cover.

*Gear-Box
Assembly.*

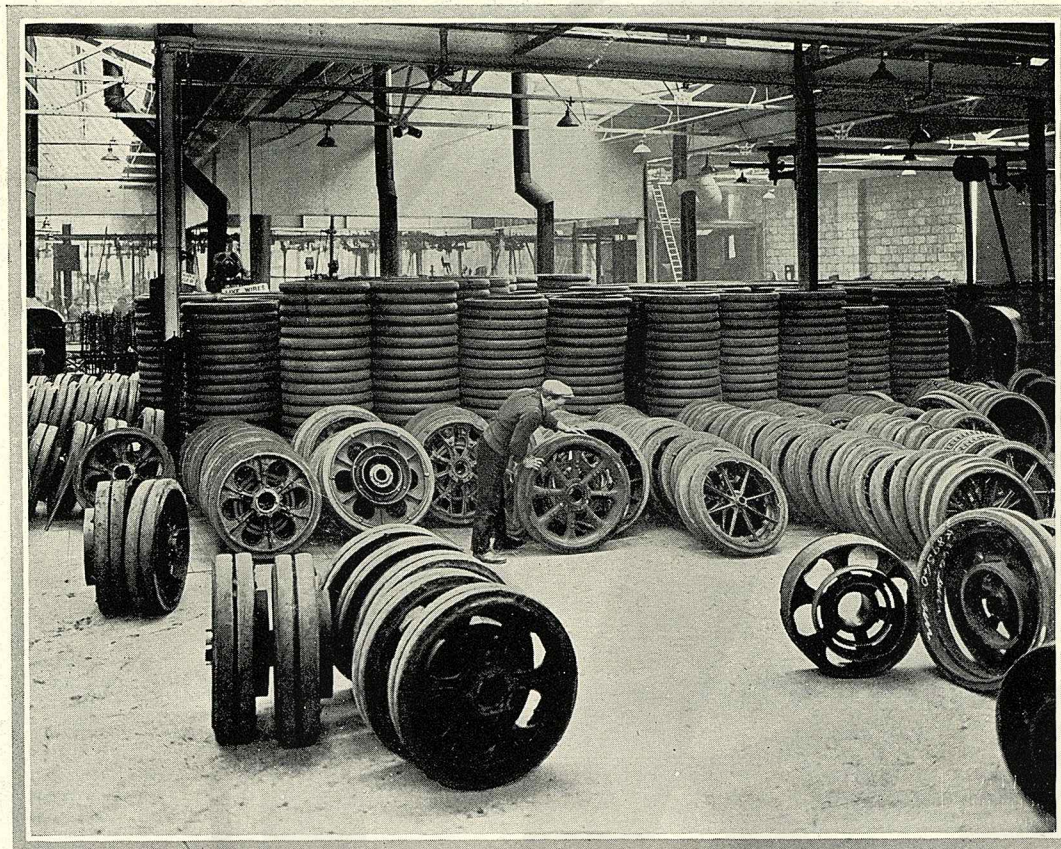


The main building occupies an area of some 300,000 square feet.

In the works the motor-bus overhaul, formerly discharged in between thirty and forty different garages scattered all over London, is now concentrated and standardised in one establishment.

Before the works were in full swing, the average time taken for a complete motor-bus overhaul was sixteen days, and this was a standard generally held to represent the greatest possible speed consistent with efficiency under the old conditions. The Chiswick system will reduce this time to four, which means a saving of twelve clear working days per vehicle per annum, while reconditioned

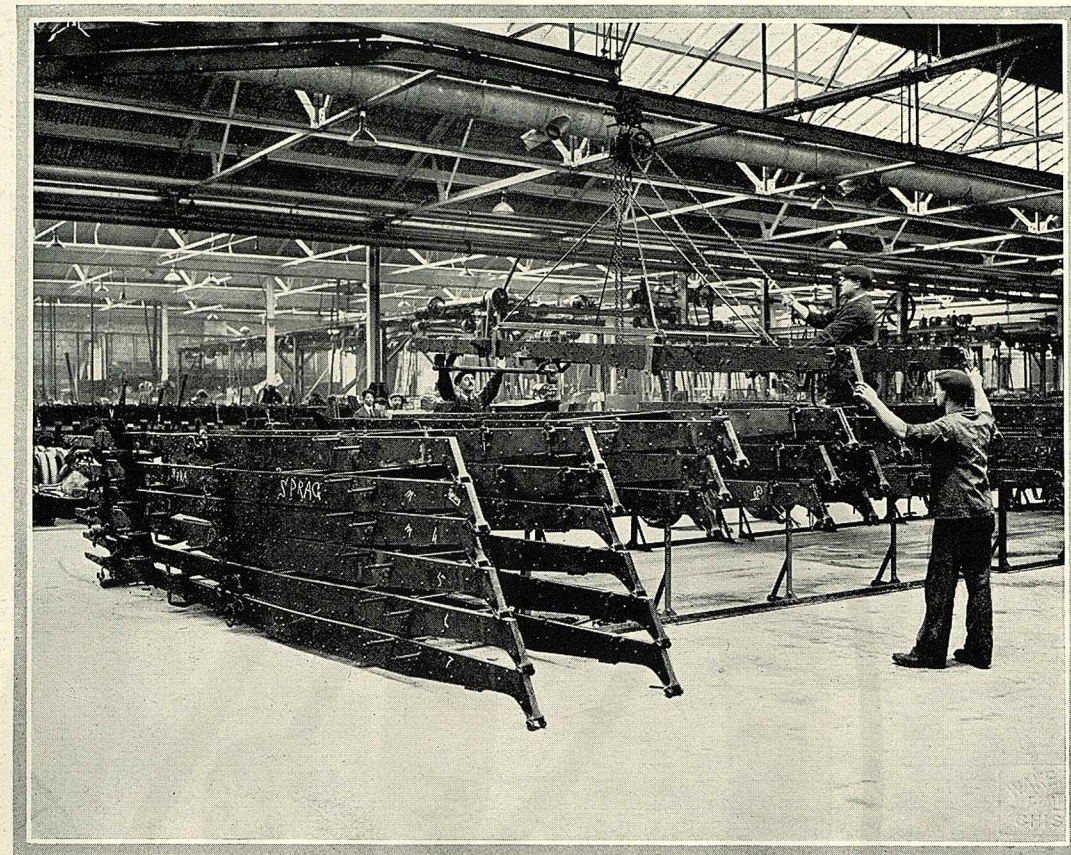
Tyre Stores.



vehicles are brought back into service four times as quickly as hitherto. In 1921 the Company operated approximately 3,000 vehicles ; hence a simple multiplication sum gives the justification for the Chiswick enterprise. This great speeding-up of overhaul makes for improvements in organisation and economies in working which are of immense importance. The annual loss in the vehicle's working capacity—hitherto $4\frac{1}{2}$ per cent.—is reduced to a fraction over 1 per cent.

Building was actually begun in September, 1920. By March in the following year a certain amount of work was being turned out

*Frames :
Repairs and
Inspection.*



in the coach-building section. The engineering side did not actually begin operations until August, 1921. By September, 1921, the weekly output of completely overhauled vehicles had reached fifty. Within two months of starting, this figure had risen to seventy-five.

The works are laid to accommodate a weekly total of a hundred units nominally, but the system is elastic enough to enable the executive to handle, during short rush periods, 120 vehicles weekly.

When in full swing, the works give employment to something like 2,000 people, the men being almost equally divided between the engineering and the coach-building sections.

Mess Room.



No modern works can afford to treat its employees as machines. Apart from any human consideration it is not good commercial economy. The underfed, overworked and harassed man is incapable of giving of his best, and in strict fact the Chiswick factory is so planned that every unit—human and mechanical—shall be a hundred per cent. efficient.

As one illustration of the human side of the organisation, 1,000 men can be served with a thoroughly satisfactory and well-cooked dinner in fifteen minutes in the works canteen, in which meals are provided at cost price. On a portion of the spare land a sports ground

*The Staff
Leaving the
Works.*



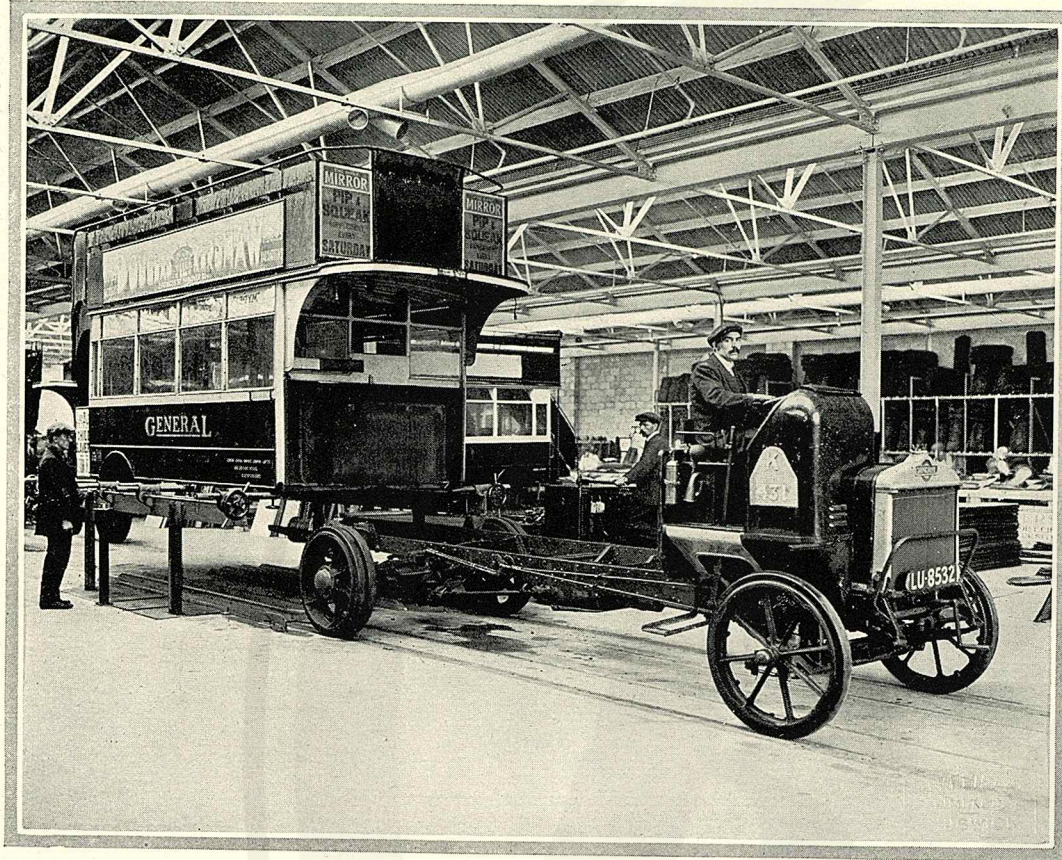
has been laid out for the use and enjoyment of the employees.

It will be of interest to follow a motor-bus through the process of re-conditioning, from first to last.

Vehicles for overhaul are driven to Chiswick under their own power. Turning in at the entrance gates, they leave the main block of offices—which are detached from the works proper—on the left, and continue to the west side of the works where, actually entering the factory for the first time, they run, still under engine power, on to marked ways to the body-dismounting shop.

The first operation is the removal of the bolts holding the coach-

*Hydraulic
Lift Gear
for Bodies.*

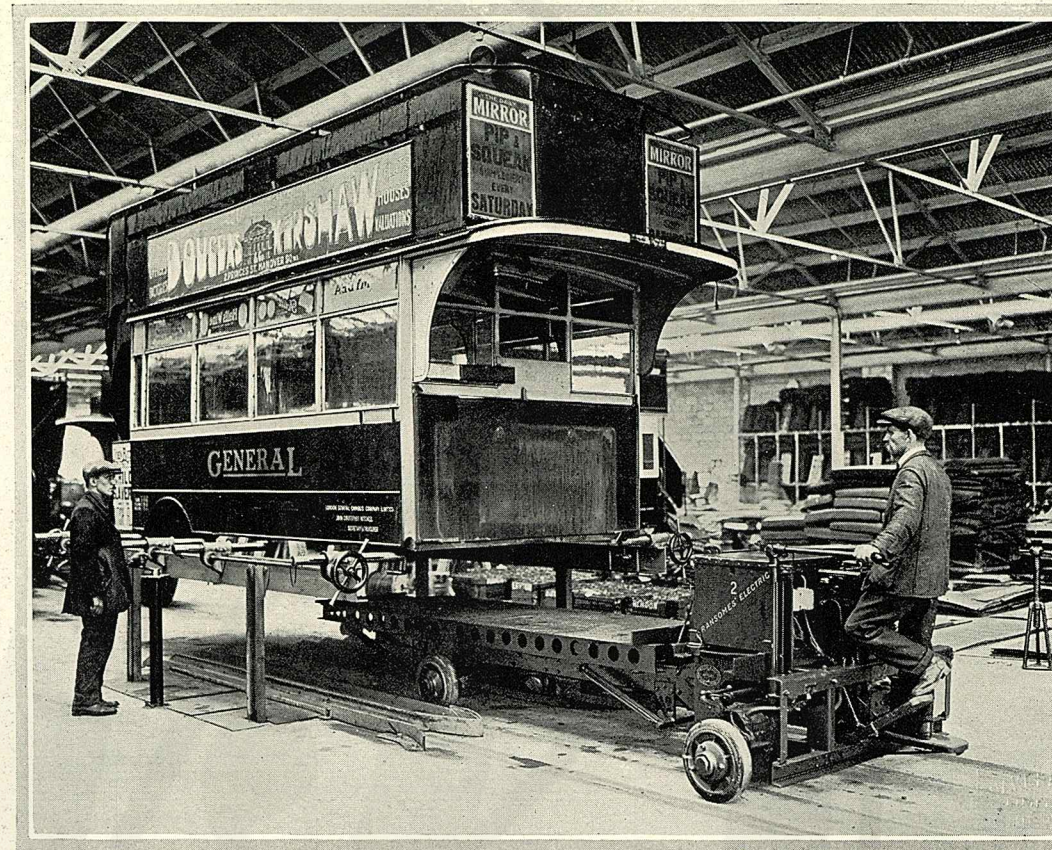


work to the chassis. A multiple hydraulic jack swings into position, and the coachwork is lifted clear, the engine running throughout the operation.

The "all clear" sign is given, and the chassis leaves the demounting shop, and continues its journey right round the works to a second gate, which is located practically in line with the first, but on the other side of the factory entirely.

The idea of this arrangement may be explained quite shortly. Both chassis and coachwork, on first entering the works, must be, in successive stages, stripped to their bare bones, reconditioned and

*Body Lift
and Electric
Truck.*

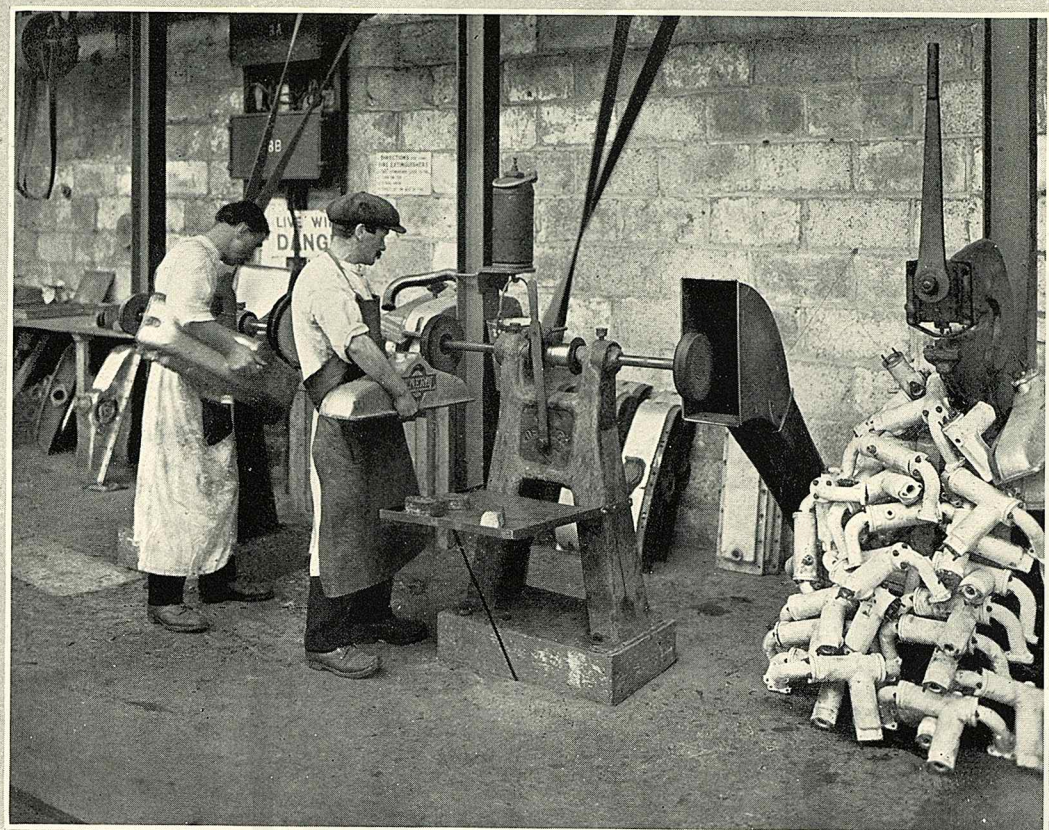


repainted. Each successive dismantling operation follows on in logical sequence.

Eventually, the reconditioned coachwork reaches the mounting department as the completely overhauled chassis leaves the works for its road test. The two entirely different sections have worked inwards, and come together, in the end, at exactly the right moment. Overlapping or delay in any department, minor or major, would inevitably result in congestion that would block the whole organisation.

The progress of the coachwork may be followed from the moment of its first being detached from the chassis. An electric trolley takes

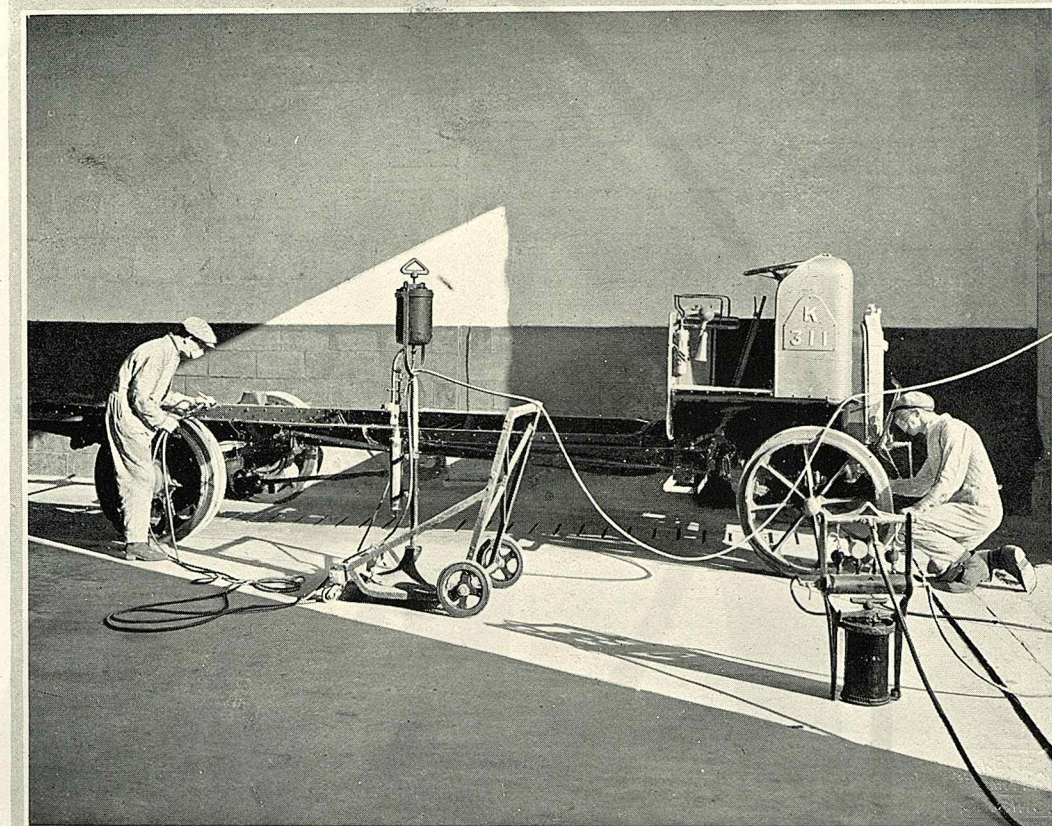
Polishing Shop.



the place of the chassis, and carries the body into the factory proper, through a lower entrance gate. In this particular section of the works—the body shop—there is accommodation for 104 units. The layout is simple. On the left-hand side, looking towards the centre of the shop, are the timber stores. Alongside are other very completely-equipped stores, containing supplies such as screws, nuts, bolts, and glass, all of which are in constant demand in the body-shop.

The whole of the supplies for these various stores are taken in by a central door on the south side of the factory. So that there may be no unnecessary movement in supplying any parts required at any

Chassis Paint Spraying.



stage of over-haul, the raw material, as it flows in at the south door, is distributed in due order over the whole range of stores. As these run the full length of the body-shop, whatever particular replacement part is needed is almost automatically to hand at any stage. This arrangement is common to both engineering and coachwork supplies.

The bodies are first completely stripped, and then reconditioned so far as their main components are concerned. Following these operations they pass into the paint shop, where there is accommodation for 57 units. Contrary to the usual practice in a big motor factory, the whole of the body-painting is done by hand, for

Trimmers'
Shop.



essentially practical reasons which long experience has justified.

The coachwork, in fact, is painted in four different colours, but no good system has yet been devised whereby one part can be covered, as it must be covered, before any spray process can be used. For flat painting and first coats, good results are obtained by using a broad-bladed palette-knife in place of a brush.

The full time taken to paint and varnish a complete vehicle is five days—an extraordinary performance, considering that the finish is as good as that on the average expensive private car. The painting completed, the body passes into the mounting and finishing

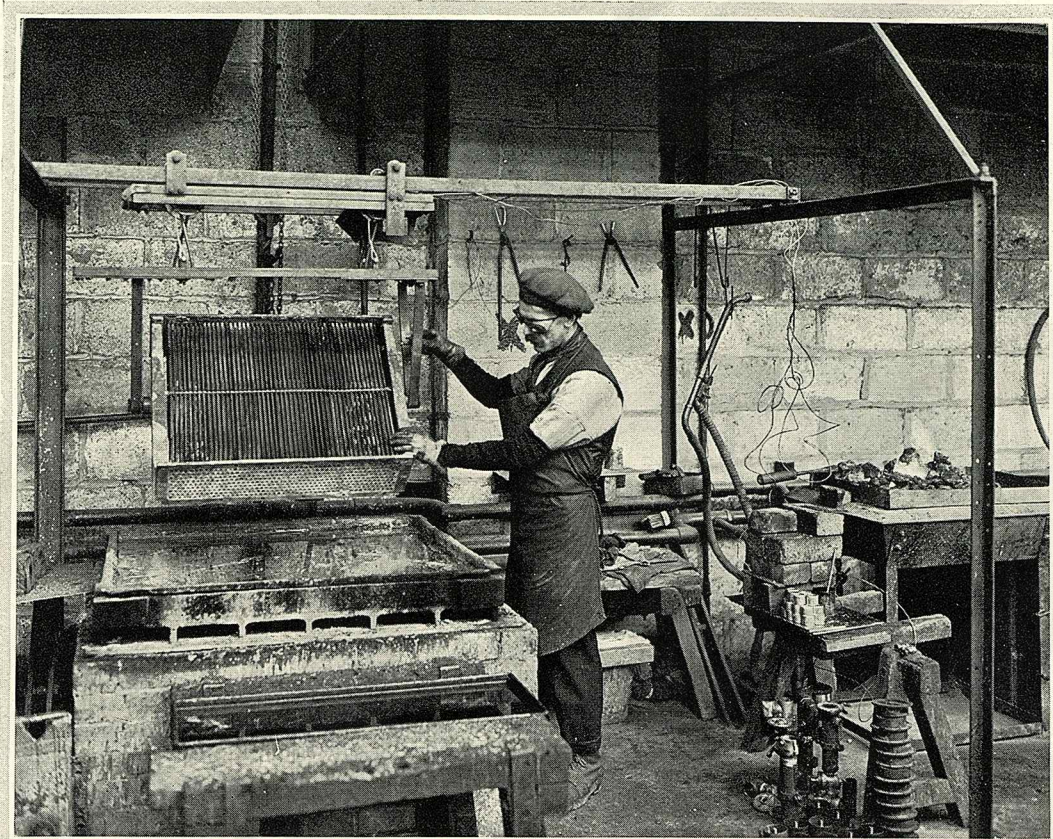
Billstickers'
Section.



shops, where it is fitted with cushions, aprons, boards and advertisements, while the electricians complete the wiring and electric fitting. In the meantime a score of different jobs have been called for, necessitating the employment of smiths, tinsmiths, and other workers.

Follow the chassis in dismantling and reassembling. Immediately the engine is stopped, the petrol tank is emptied and the fuel drained, by an underground pipe, into the main storage tank. As each chassis part is taken out, it is moved, by rollway or conveyor, according to its size, and completely dismantled. Each part is tested and inspected before it journeys down the line of workers and benches. The stores

*Sweating
Radiator
Tubes.*

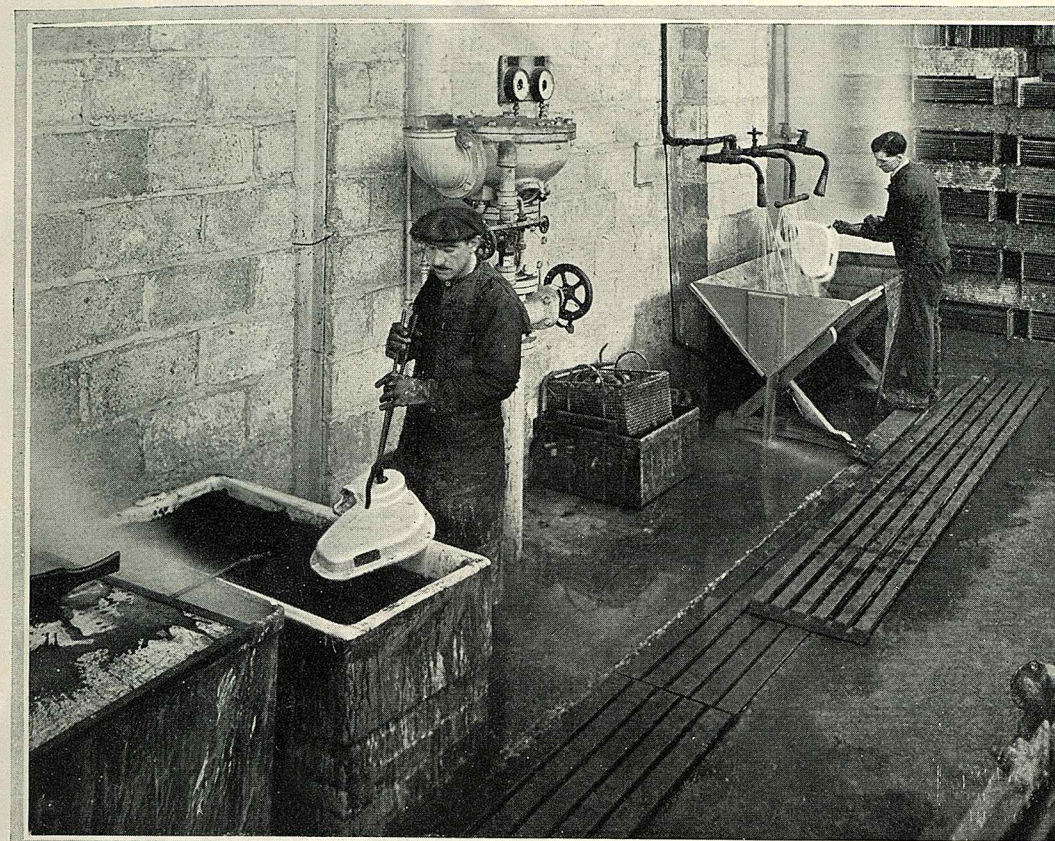


are drawn on for the replacement of parts which have become worn.

Radiators, bonnet-boards and petrol tanks are the first components to be dismantled. The very thorough radiator-washing provision is unusually interesting, serving, as it does, the dual purpose of throwing up every weakness and sign of wear, and preparing the component in advance for repair.

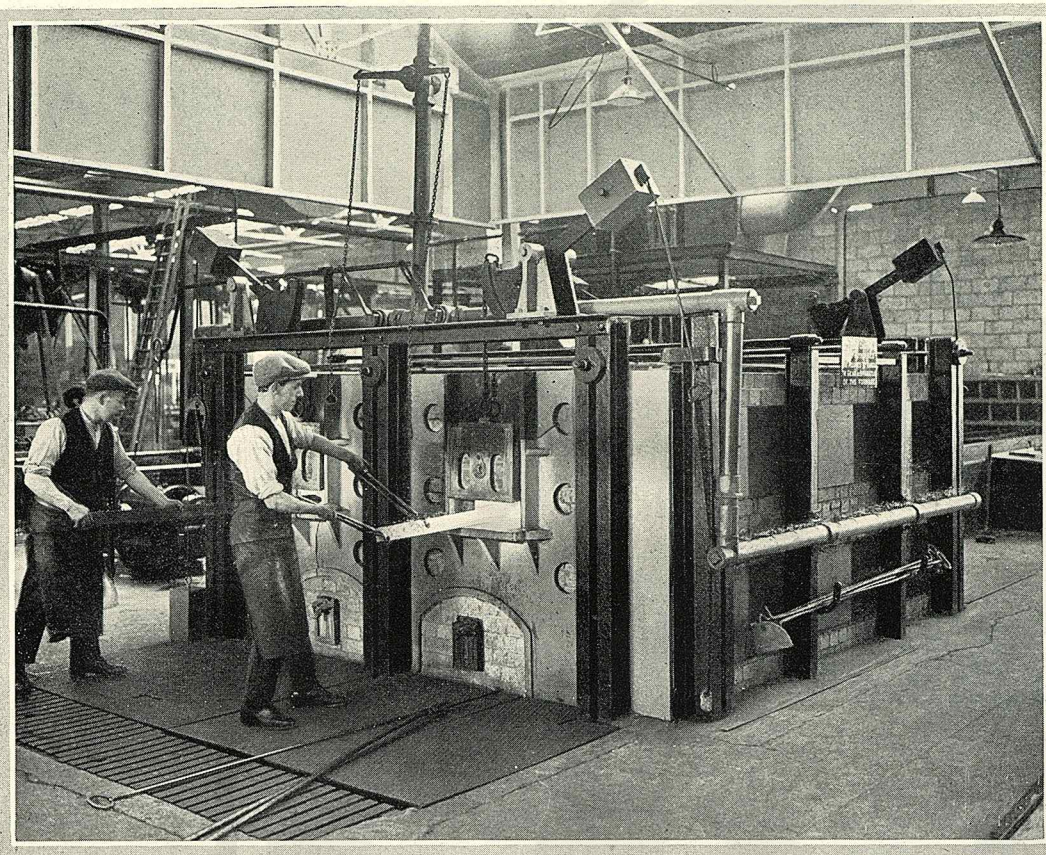
One of the greatest difficulties confronting the motor repair shop is that of obtaining perfect cleanliness in parts grimed and greased by a year's work. The special washing-machine, designed at Chiswick to overcome this trouble, is the most successful effort of

*Chemical
Cleaning :
Aluminium
Parts.*



the kind yet conceived. This machine takes the form of a big-diameter tunnel, carrying, on its inner diameter, coiled piping perforated with many thousands of $\frac{1}{8}$ -in. holes. A high-temperature caustic solution is forced through the perforations by means of a 6-in. pump, the result being that thousands of high-velocity jets play on every part, from every angle, as the component passes through the tunnel on an automatic conveyor. Three machines of this type are installed. As each is capable of accommodating five components, such as gearboxes, at one time, the total capacity of the washing plant is easily calculated.

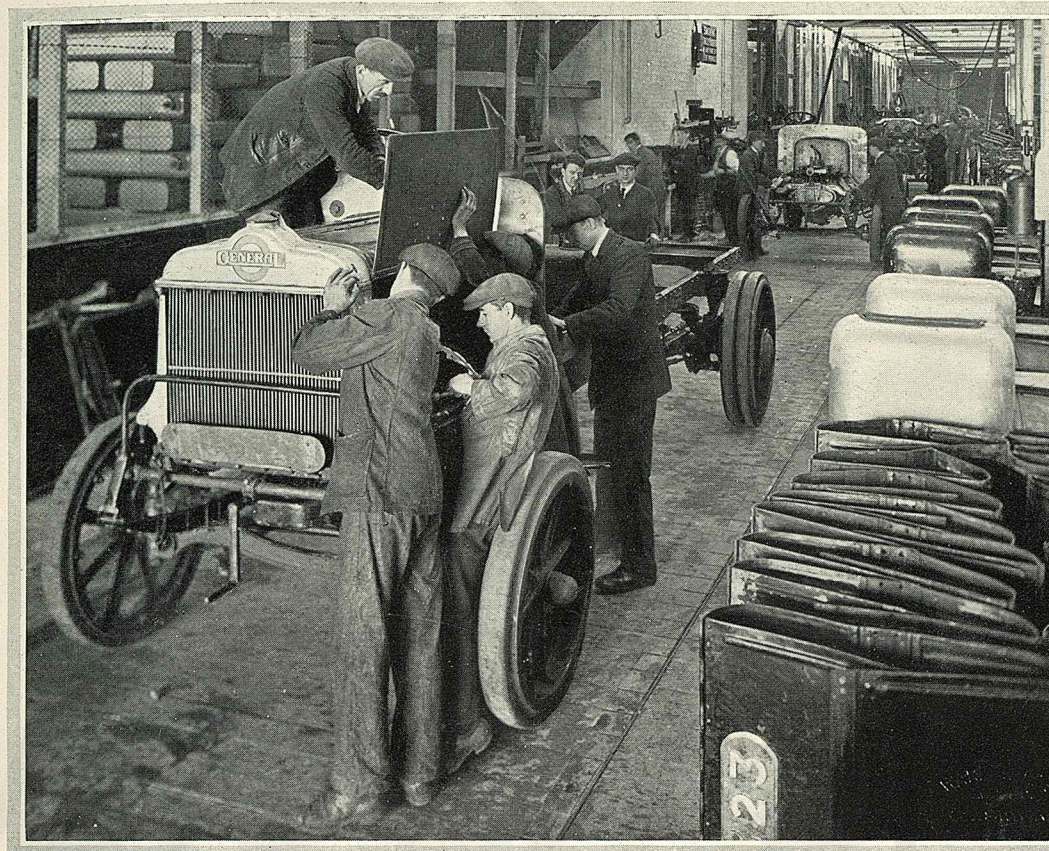
*Gas Fired
Spring
Furnace.*



As the chassis passes along the shop, it is gradually stripped of engine, clutch, gearbox, brakes, back and front axles and steering gear, and all other fittings, down to the bare frame. The wheels go into their own special shop for retyring, the tyres themselves being taken from the store immediately adjoining.

The springs are reheated in a double-ended reverberatory gas furnace, with a capacity of 120 springs a day, partly because it is impossible to detect incipient cracks without such treatment, and partly to remove the fatigue brought about by months of wear ; also for retempering. After tempering, each spring is tested to a fifty

*Chassis
Erection.*



per cent. overload. The millwright's, tool-room, and electrical departments are also located in this section of the works.

After the frames have been inspected, repaired and passed as fit for further service, the retempered springs are mounted, and the embryonic chassis begins what may be called the outward journey through the works—in other words, reassembling begins. As the frame passes along towards the main moving platform which runs practically the full width of the shop, front and rear axles are also being reassembled until, when they actually reach the main conveyor, they practically fall into position.

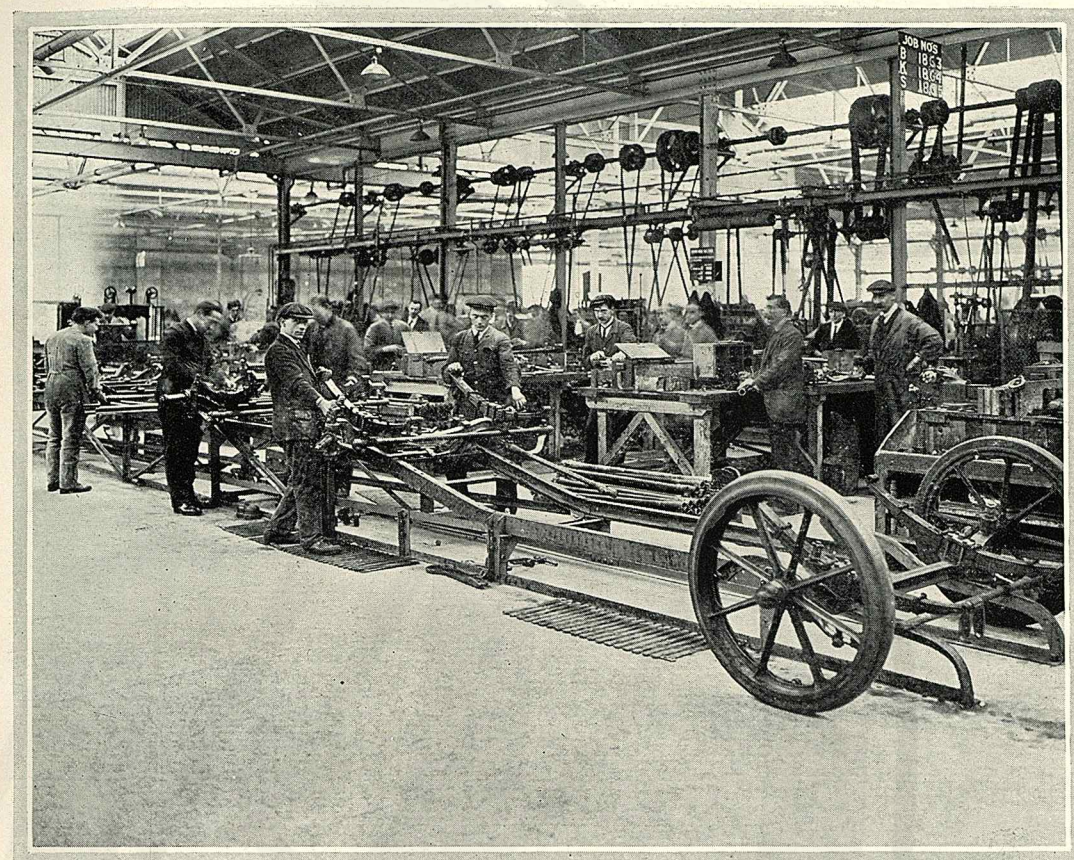
*Material
Conveyor.*



Once on the main platform rebuilding is chiefly a matter of bolting the various units into position. The total length of the platform is 220 feet, and one may walk up the full distance and see, in the course of an hour or so, a chassis completely assembled.

The accompanying illustration of the factory layout shows very clearly the respective paths of the various components from the time they are stripped from the chassis until, completely rebuilt and tested, they reach the main platform. There is neither waste movement or unnecessary delay. At exactly the right moment they arrive at the platform ready to drop into the chassis.

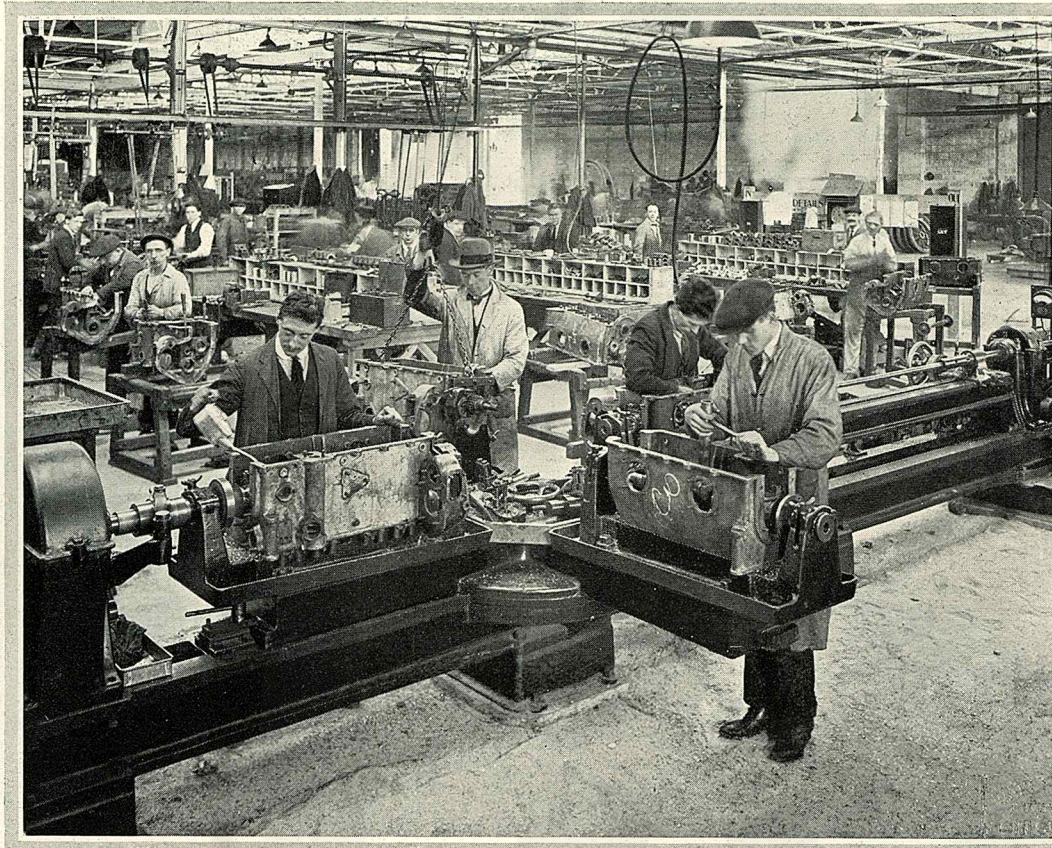
*Front Axle
Assembling.*



Gearboxes and rear cardan shafts, steering boxes and drop arms, hand brake and gear levers, and all the ordinary complicated gear of a chassis which, however, seems to lose complication and to be simplicity itself when handled in this methodical manner. In due order the parts make their appearance.

As the frame and transmission nears the end of the platform, the time arrives for the engine installation. The rebuilding of the engines deserves particular mention. There is a wonderful boring, reamering and running-in machine installed centrally between the point where the engine is first taken from the chassis, and the point

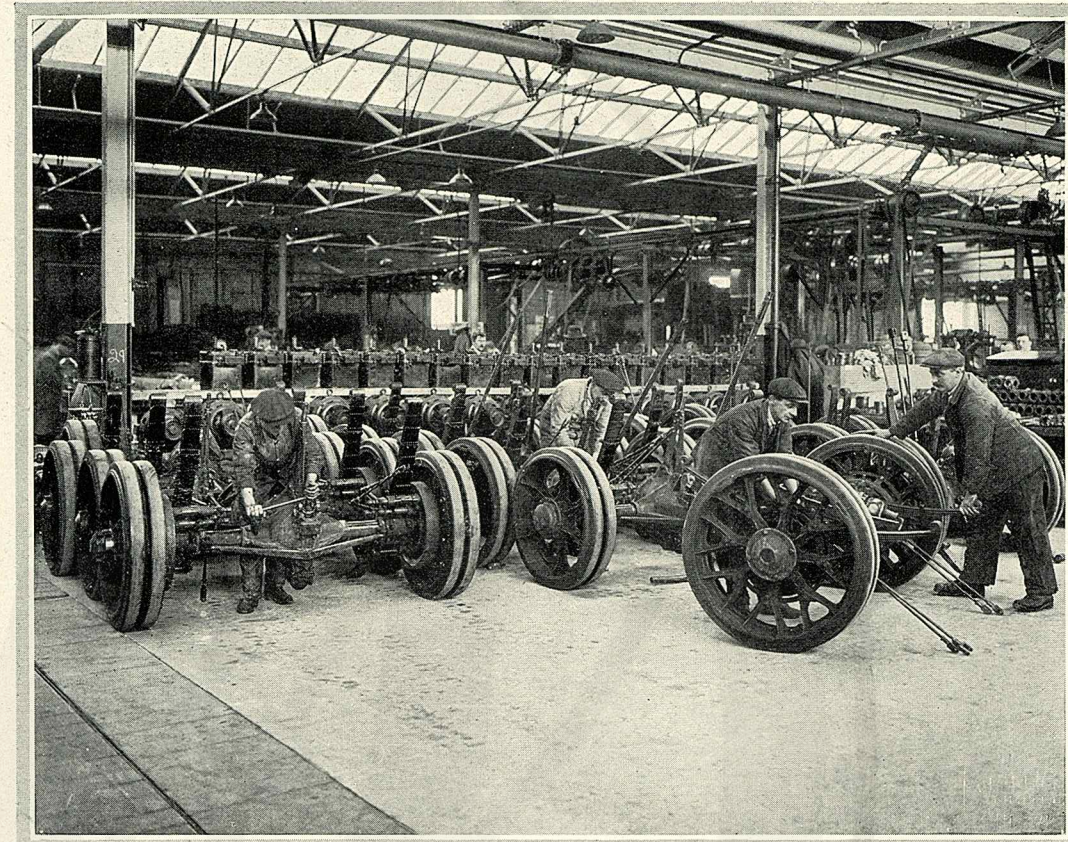
*Special
Reamering
and Crank-
Fitting
Machine.*



where, completely rebuilt, it joins up on the main moving platform.

This boring, reamering and running-in machine is worthy of especial attention, for it is unique. It was designed in the Chiswick works. A noteworthy point about it is that it reduces what was formerly a two-day task for skilled fitters to a twenty-minute affair for a machinist.

With the remetalled bearings bolted down in position exactly as when the crankshaft is installed, the whole crankcase is gripped in a jig which makes the ordinary lengthy business of "lining up" unnecessary. The boring bar is sent through; jig and job together

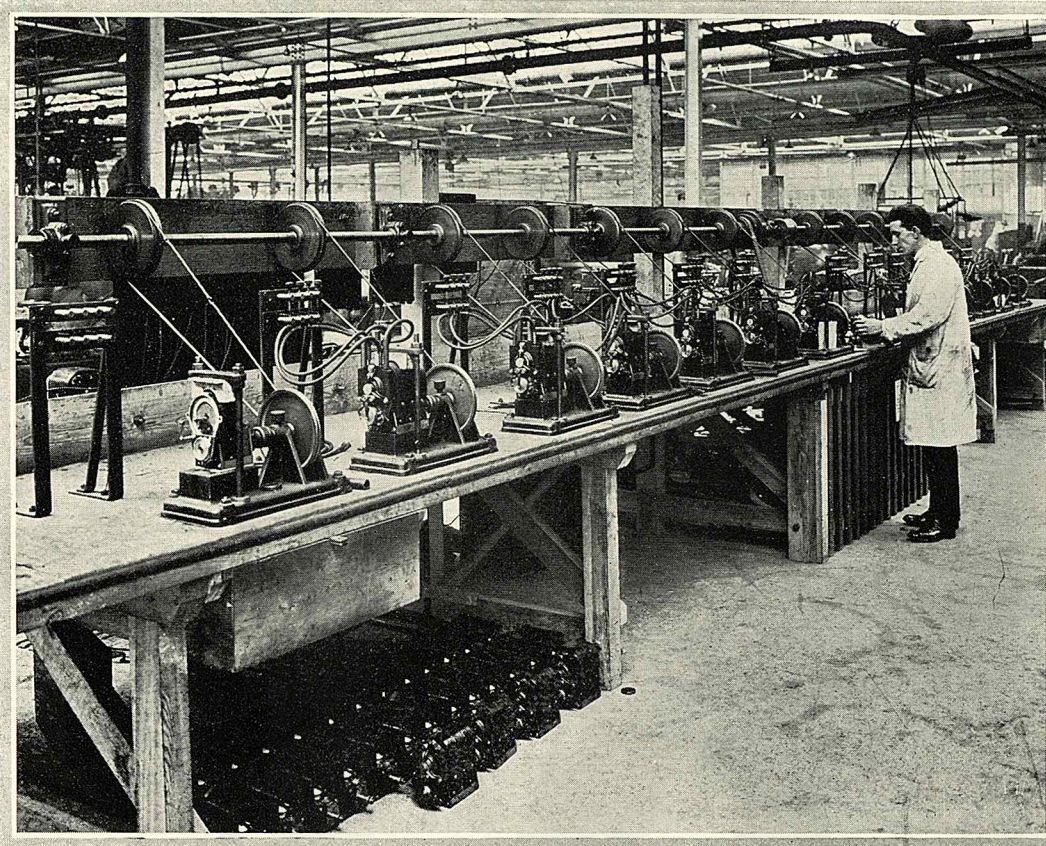


*Rear Axles
Ready for
Platform.*

are swung over to the second arm of the machine, and the reamer gets to work; the top half of the lining is removed, the actual crankshaft to be used in the engine dropped in, the lining is replaced, and the machine starts its last operation of "running in" the shaft. It is amazingly simple and effective.

In the meantime all other engine parts are being overhauled. Worn cylinders, rings, pistons, gudgeon-pins, timing gears and bearings are renewed or passed as fit for further service, all eventually being assembled on a moving platform. When the chassis has moved far enough up the main platform, the engine, complete with

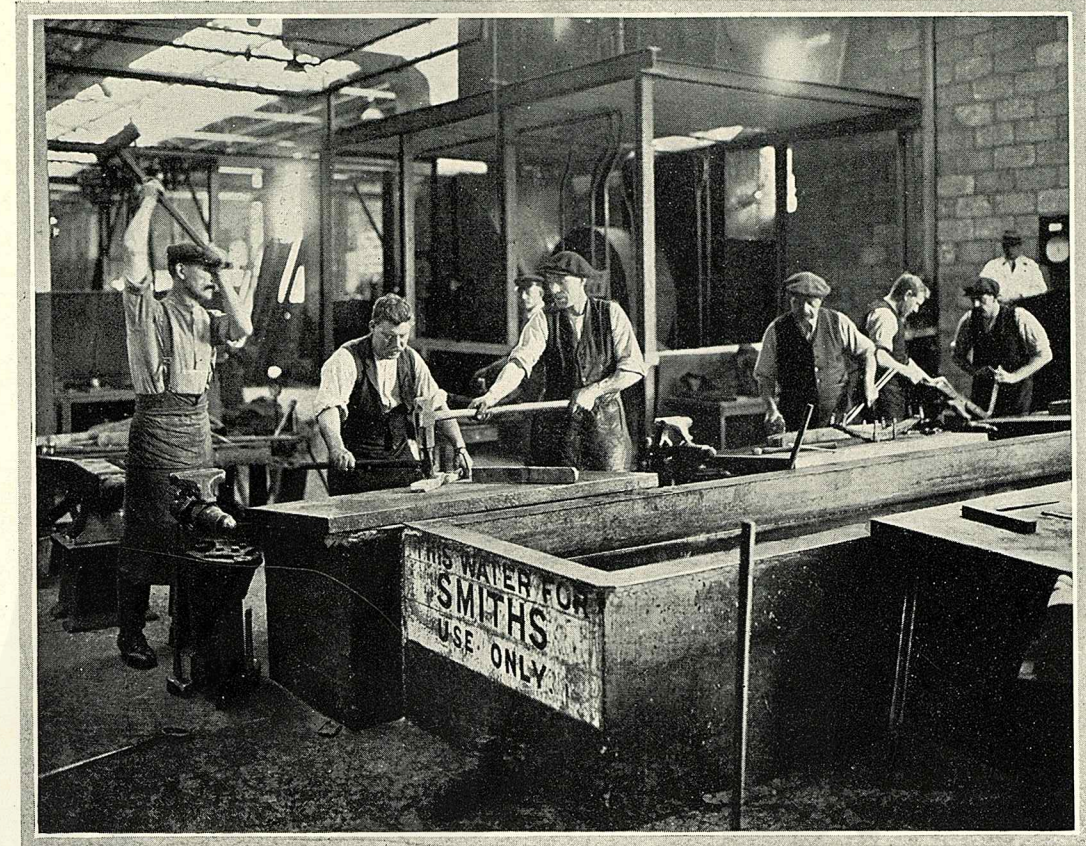
*Magneto Test
Stands.*



all its auxiliary gear, leaves the moving conveyor ready to be dropped into place and bolted down.

Radiators, tanks, electric equipment, and details by the score, are fitted in due order, and to a decimal part of an inch. It is not enough that they be perfect in themselves, but it is demanded that they fit with almost microscopic exactitude in their relation to all other parts on the chassis. The system ensures it. If there be any deviation, the system brings it right home to the particular section, gang foreman, viewroom man, bench, and actual worker concerned.

*Spring
Setting.*

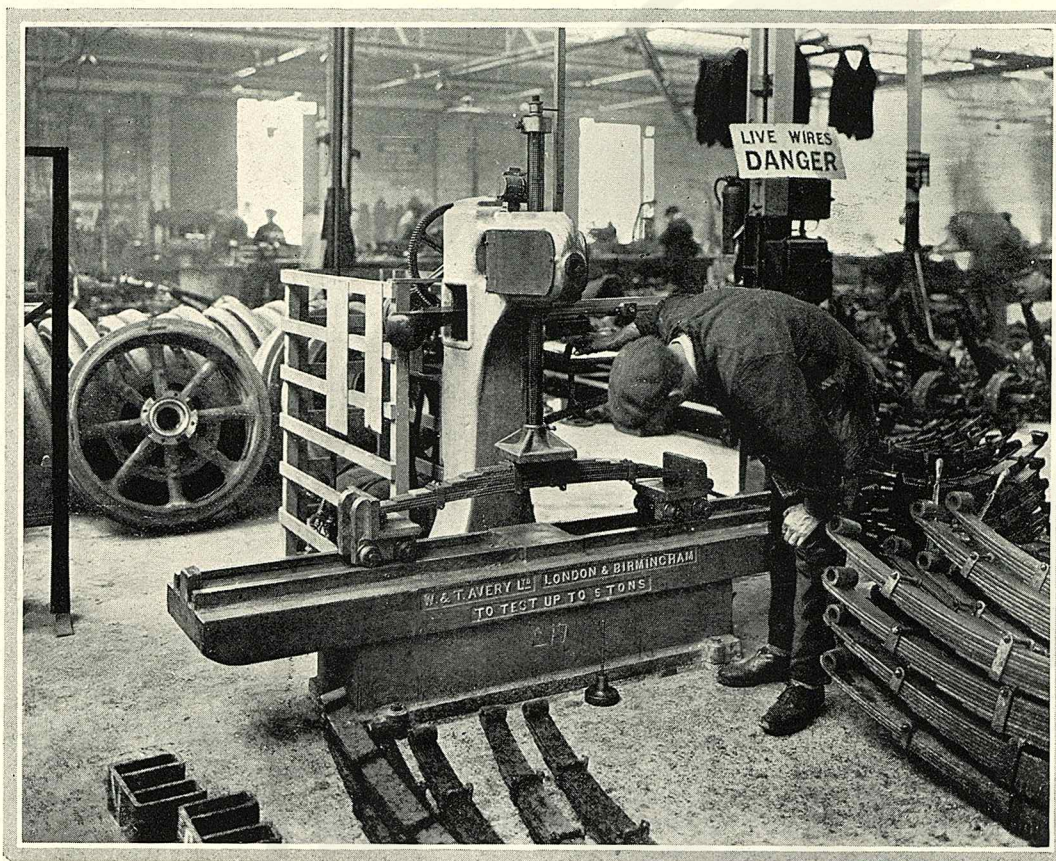


The chassis is completely erected by the time it has reached the end of the platform.

The radiator is filled ; six gallons of petrol are fed to the fuel tank ; engine, gearbox and back axle have already been supplied with their fixed quantities of lubricant ; every knuckle, grease-cup, bearing and joint has received attention ; a tester climbs into the driving seat, the chassis passes on to a further position, where the engine is started by a machine operating through the rear wheels, and the unit leaves the shop under its own power for the first test run.

Outside the works testing roads have been built, with a rough

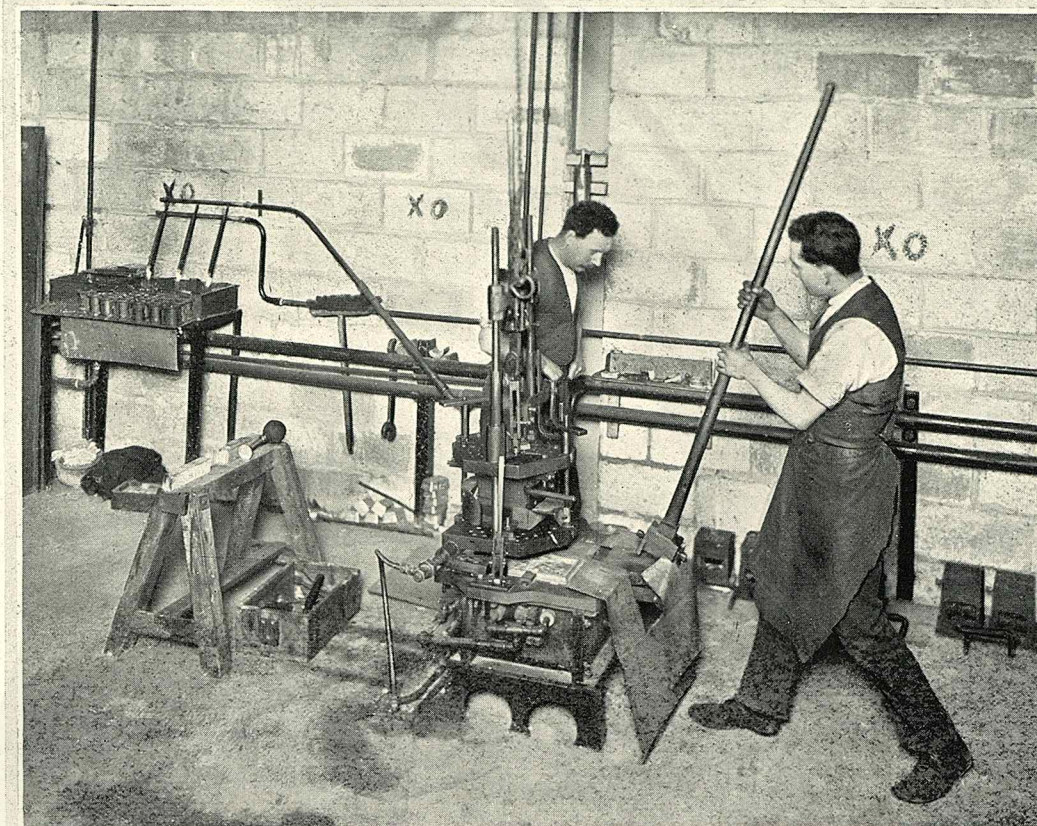
*Testing
Repaired
Springs.*



surface and a gradient of 1-15—approximately as severe a test of brakes and pulling power as the chassis is likely to experience in the course of ordinary service. This testing-place, constructed as a part of the general scheme, involved the making of eight hundred feet of graded roadway with a double hill. From the excavations all the sand and ballast required for the buildings were obtained.

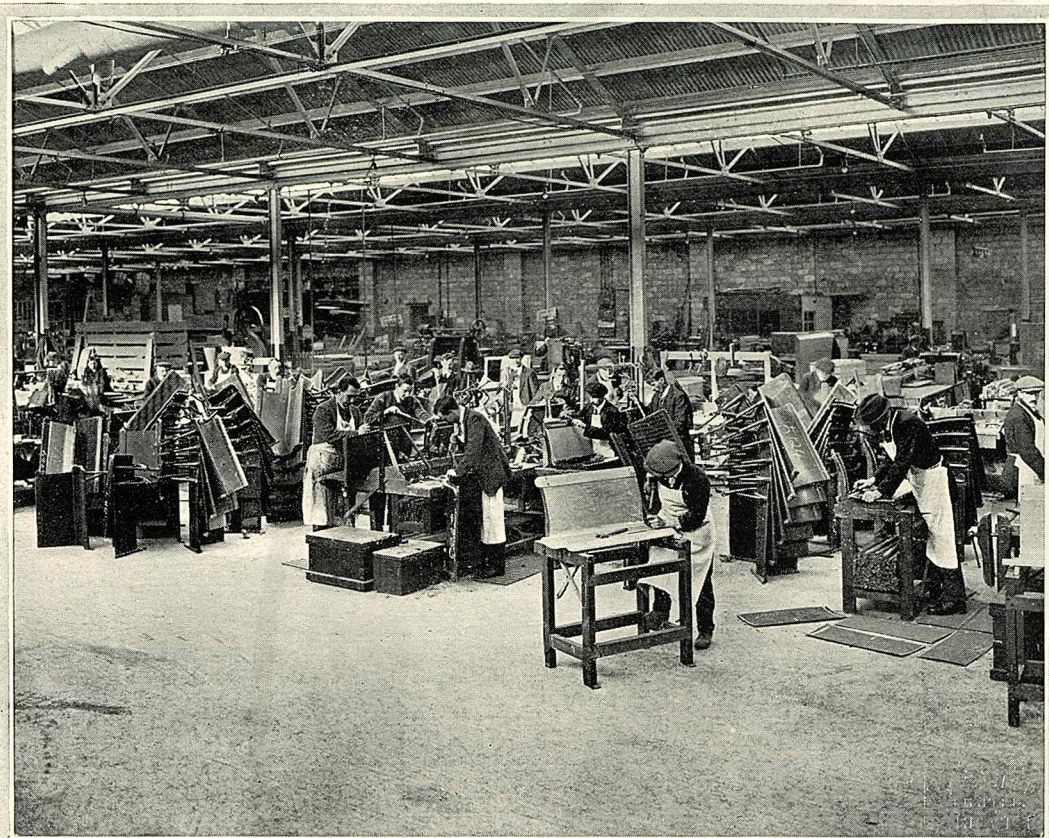
Having successfully passed the running test, the chassis is handed over to the licensing department of the works, by whom it must be approved before going further.

*White Metal
Die Casting.*

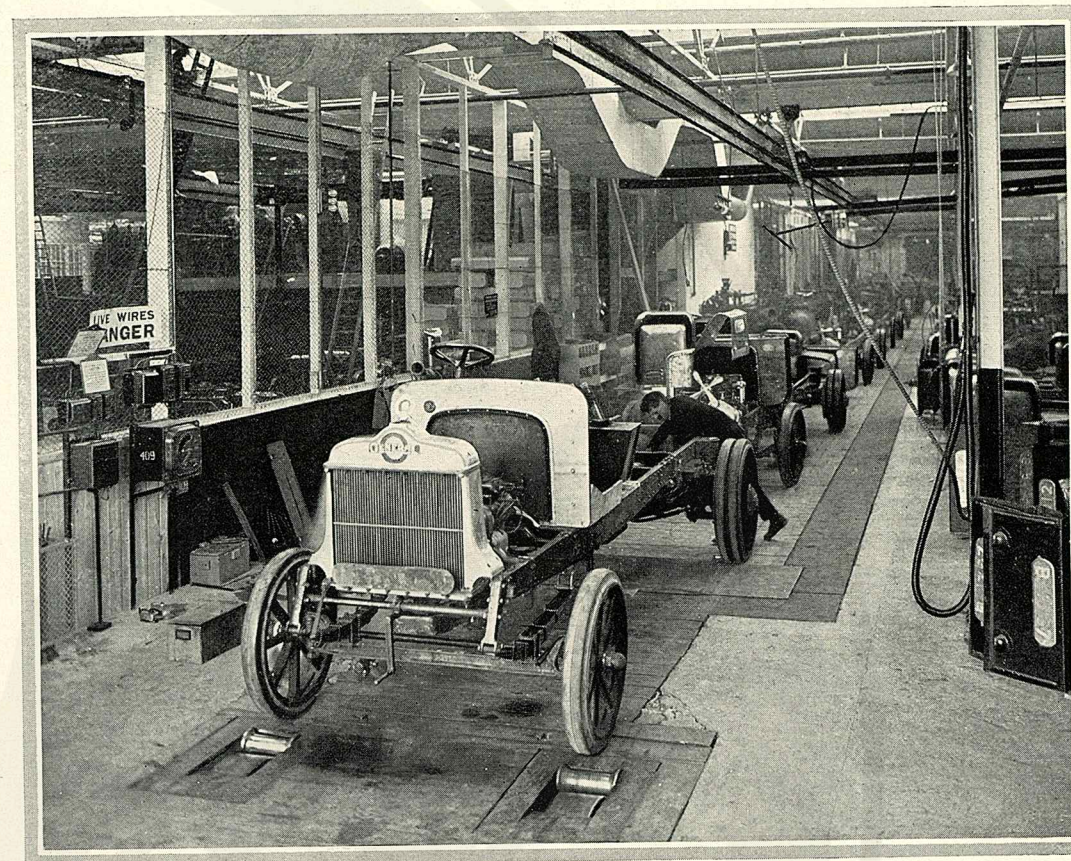


The chassis runs on to its registered track, the coachwork has preceded it by electrical truck, and is held in position on multiple hydraulic jacks similar to those used for dismounting the body in the first place, but in this case the heads have each some degree of universal play to allow for any slight lack of register in the boltholes of coachwork and chassis. The nuts are screwed home on the holding-down bolts, the battery terminals are coupled up for final test before being submitted to the Police passing station—a clean sheet from the authorities being necessary—and the vehicle “passes out,” fit for another 30,000 miles of running.

*Coach Department :
Preparation
Shop.*



In any short and necessarily condensed account such as this must be, it is impossible to give detailed attention to a host of interesting matters. The visitor, however, can, with the help of the general illustration of the factory lay-out already referred to, get an excellent idea of the whole scheme well into his head. He should notice how clean the whole arrangement is—there is no retracing of steps, no overlapping. As every part of either coachwork or chassis is dismantled, it immediately begins a journey which brings it out, either repaired or replaced, at the exact moment and position where it is needed in the reassembling of the whole job.



*Engine-
starting
Device at
End of
Platform.*

The location of all the stores and offices is worth noting ; moving platforms and conveyors are utilised on a bigger scale than in any other factory in Europe. The 6-ins. per minute engine conveyor and the extremely ingenious gearbox roller have both exceptional interest.

A very modern experimental shop is on the spot. In the laboratory raw materials, fuels and lubricants are tested. There is a darkroom for photography tests, and lastly there is the first-aid and rest room, where accidents may be treated without delay.

There is no motor repair shop in the world that can justly be

*One Day's
Output.*



compared with this enterprise with which the London General Omnibus Company have inaugurated the season of 1922.

The main entrance to the Chiswick Works is quite close to Gunnersbury Station on the Richmond branch of the District Railway, a short half-hour's journey from Charing Cross. On the South side of the works runs the Chiswick High Road, which is served by the London United Tramways from Shepherd's Bush, Hammersmith, Hounslow, Twickenham and Brentford, and by many "General" motor-bus routes. Both from the railway and from the road the works are an unmistakable landmark.

Chairman and Managing Director :
THE RIGHT HON. LORD ASHFIELD OF SOUTHWELL

Principal Officers :
Chief Engineer and Operating Manager :
G. J. SHAVE

Engineer
in Charge :
C. LEESE

Experimental and
Research Engineer :
OWEN W. J. WATSON

Coach Factory
Superintendent :
S. GAGE.

Production
Engineer :
G. RUSHTON

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