

SECTION 7, CHAPTER 3

CHASSIS—SUSPENSION—WHEELS—TYRES—BRAKES

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Introduction

1. Much of the ground equipment required for the day-to-day operation of modern aircraft must of necessity be readily transportable. This necessitates quite a number of

different types of trolleys, because the equipments are widely varied both in weight and volume. Also, the design of the trolley will be affected by the area of operation, i.e. whether the equipment will be required for

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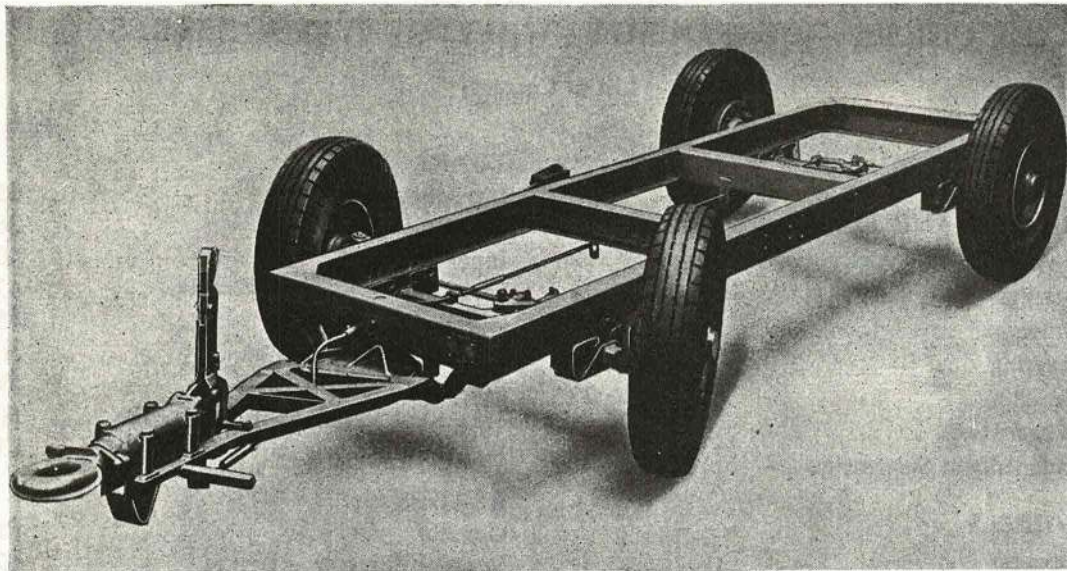


Fig. 1. STANDARD 35 CWT. CHASSIS.

use inside hangars or workshops only, or whether it will be used on the airfield. In general, a trolley will consist of a chassis, provided with adequate mountings for the suspension and towage, wheels, tyres and, if necessary, a braking system. The following information does not describe any of the trolleys in detail, and is only intended as a broad outline of what may or may not be incorporated; a typical example is shown at Fig. 1.

CHASSIS AND SUSPENSION

Two-Wheeled Types

2. The chassis required is very often a simple rectangular frame, which may be constructed of channel, angle or tubular sections, welded together to form a strong, rigid assembly. Attached to the frame are the required mountings for the suspension, and provision is made for towage. Where it is possible, some part of the equipment may be incorporated as an integral part of the chassis; for example, the air reservoir of a compressor may be utilized to replace the separate frame, in much the same way as the body shell has replaced the chassis on the modern light car.

3. The smaller two-wheeled trolleys usually incorporate a handle, designed for manual movement or towage of the trolley, which is integral with the chassis frame. Also,

mounting these trolleys on low pressure balloon type tyres obviates the need for sprung suspension, and in such cases the solid axle is normally bolted direct to the frame.

4. When heavier and bulkier equipment is involved the trolleys are of course larger, and some method of absorbing the shocks caused by movement over uneven surfaces must be incorporated in order to prevent damage to both the chassis and the equipment. Rubber, coil springs, and laminated leaf springs are used for this purpose, but it will be found that the several types of laminated leaf springs are the most widely used. This information on suspension is also applicable to four-wheeled trolleys.

Springs

5. Although there are applications where coil and quarter-elliptic springs are used, the majority of ground equipment trolleys are fitted with leaf springs of the semi-elliptic type (Fig. 2). The names semi- and quarter-elliptic springs arise from the fact that two semi-elliptic springs used together, as they have been so used in certain applications, resemble an ellipse.

6. The ordinary leaf spring consists of a long strip of steel known as the master leaf, and a number of shorter strips or auxiliary leaves of gradually diminishing length. The

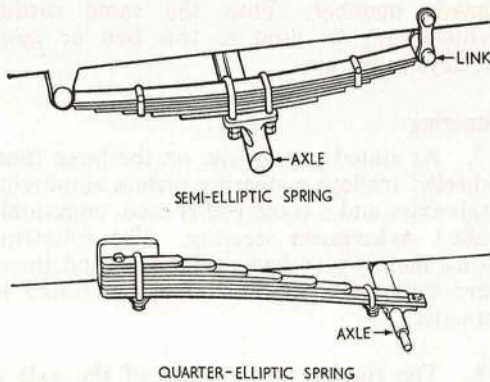


Fig. 2. SPRINGS.

master leaf is formed with an eye at each end, to which are attached the shackles connecting the spring to the chassis. At least one end of the spring must be connected by means of a link, to allow for variation of the distance between the two eyes. The leaves are held together by a centre bolt, the head of which registers in the spring saddle, though this bolt may not always be in the centre of the spring. The shackles may be bushed with phosphor bronze, in which case a lubrication nipple is usually provided, or with Silentbloc rubber shackle bushings. When the latter type are fitted, the weight of the trolley should be on the springs before the shackle bolt nuts are finally tightened in all cases when a spring is being fitted. This ensures that normally the rubber comprising the bush is not subjected to strain, but that it twists equally to spring deflection or rebound. The spring-to-axle security nuts should also be tightened finally with the weight of the trolley on the springs.

7. A semi-elliptic spring is secured to the spring seat by four bolts and a cap piece or by two U-shaped stirrups. Various arrangements are used to position the leaves sideways. The leaves are sometimes produced with "pips" or projections on their upper surfaces which fit into corresponding recesses formed in the undersides of the leaves. Clips are the most widely used device, and they also serve another purpose. The clips ensure distribution of the load over all the leaves, and thus prevent excessive loading of the master leaf on rebounds. Short rebound leaves fitted on top of the master leaf are sometimes used for a similar purpose.

8. It will be noted from the diagram (Fig. 2) that semi-elliptic springs are secured at one end direct to the chassis frame, whilst at the opposite end a link is interposed between the spring and the frame. This arrangement is necessary to allow the spring to "flex" under load; increase of load will, of course, cause the distance between the eyes of the master leaf to increase.

9. Laminated springs do not require much attention, but they should be kept clean externally. Some springs do not require lubrication, but when this task is laid down in the servicing schedule, the chassis should be jacked up until the wheel is clear of the ground so that the leaves can be opened up and oil or grease inserted; the clips must, of course, be removed to allow this work to be carried out.

10. The lubrication of shackle pins is also important, because the loading on them is fairly heavy and causes rapid wear when lubrication is neglected. It is often advisable to jack up the chassis when lubricating the shackle pins, so that the load will be on the side of the pin opposite to normal; this allows the grease or oil gun to force out the old lubricant and deposit new lubricant on the bearing faces of the bush and pin.

11. "Silentbloc" bushes must not be lubricated, because relative motion between the connected parts is accommodated by distortion of the rubber of which the bush is composed, and grease or oil causes rubber to deteriorate rapidly, thus rendering the bush unserviceable. Under dry conditions these bushes may tend to squeak, and at such times they should be soaked with soapy water.

12. The nuts on the bolts or stirrups used to secure the springs to their seats must also be checked periodically for tightness.

Towbars

13. Movement of a trolley is obtained with the aid of a towbar, the design of which is dependent upon the size and usage of the particular trolley. The "pram" type of handle is adequate for a small, relatively light trolley, which in all probability will only be used in hangars, workshops, or on fairly flat surfaces such as hard standings or dispersal points. Some trolleys are manoe-

uvred by a swivelling bogie or turntable fitted with a towing yoke which may be hinged. Towbars may be fixed or adjustable to suit the height of the towhook on the towing vehicle.

14. For the larger types of trolley, for example those weighing one ton or more, the simple types of towbar are of no use, and a typical example of those in use, is shown at Fig. 1. In this case, the drawbar frame is constructed of welded angle section mounted on the front cross member, and having a steering lock of $33\frac{1}{2}$ degrees either way. It operates Ackermann type steering (para. 17) on the front wheels, which is similar to a road transport vehicle having swivel pins, track rods, draglink, etc.

15. A standard F.V.D.E. towing eye (Fig. 3) is fitted to the drawbar. The assembly incorporates a buffer spring to damp out any sudden shocks caused by sudden acceleration and deceleration. Provision is also made for operation of the braking system by means of an overrun device, and an overrun lock for engagement when reversing prevents operation of the brakes at such times.

16. Some trolleys are also equipped with a standard towing hook fitted on the rear

chassis member. Thus the same towing vehicle may be used to tow two or more trolleys in a train.

Steering

17. As stated previously, on the large four-wheeled trolleys a steering system employing stub axles and a track rod is used, commonly called **Ackermann** steering. The following notes merely give basic principles and therefore differences in detail may be found in practice.

18. The rigid centre section of the axle is mounted on one of the various types of springing, and only the extreme ends of the axle are made to move about their own vertical axis (Fig. 4). The pins that form these axes are known as **king pins** or **swivel pins**. That part of the axle that is outboard of the swivel pin is known as the **stub axle**. Fixed to each stub axle and pointing rearwards is a **stub axle arm**, and these two arms are connected by the **track rod**, which is usually in one piece but may be split. This rod lies parallel to the axle and maintains the correct alignment of the front wheels, being usually set up so that the wheels are turned slightly inwards towards the front, i.e. slight **toe-in**. The towbar is arranged to

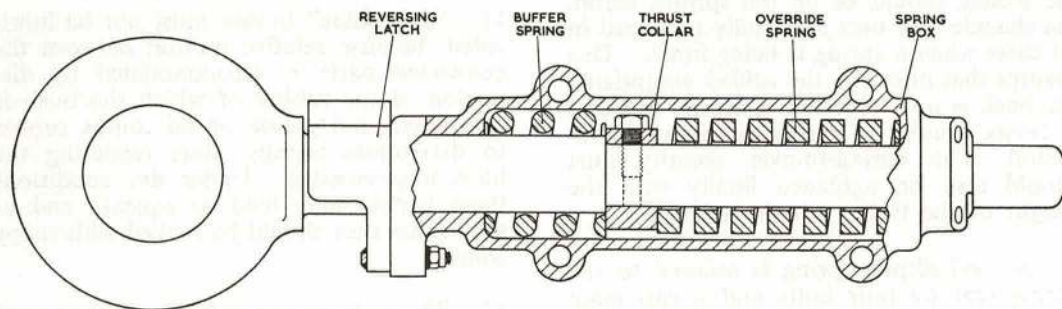


Fig. 3. TOWING EYE ASSEMBLY.

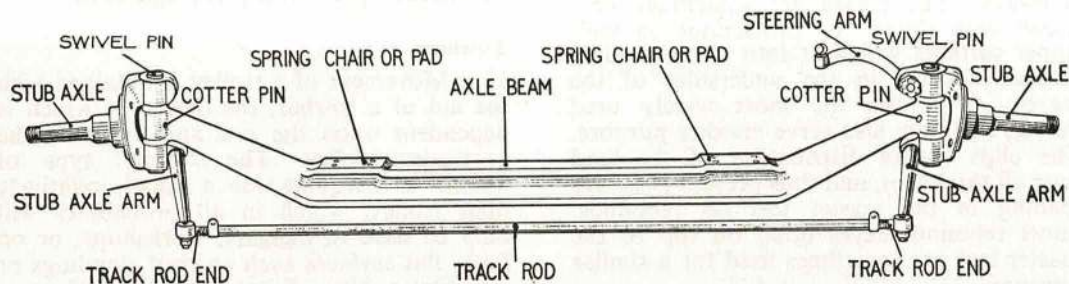


Fig. 4. FRONT AXLE ASSEMBLY.

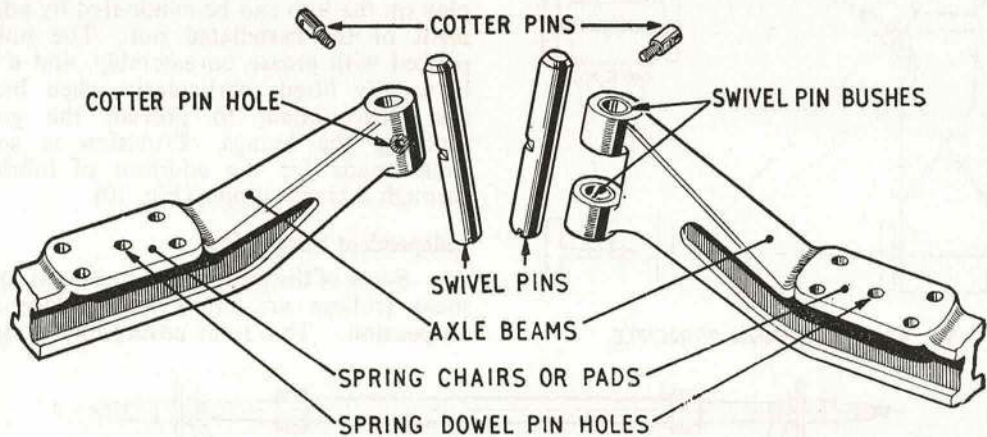


Fig. 5. AXLE BEAMS WITH PLAIN END AND WITH YOKE END.

deflect the **steering arm** or **draglink**, thus turning the stub axles in the required direction.

19. The ends of the axle beam are formed either with plain or yoke ends (Fig. 5) to suit the type of stub axles; these may be **Elliot** (Fig. 6) or **reversed Elliot** (Fig. 7). In the Elliot design the swivel pin is fixed in the stub axle forging, and the ends of the swivel pin can turn freely in bushes fixed in the axle beam fork. The reversed Elliot design has the swivel pin fixed in the end of the axle beam and locked by a cotter pin, so that the forked stub axle can turn on the ends of the swivel pin.

20. **Ackermann Steering.** This is the layout used to maintain true rolling motion without tyre scuffing and vehicle instability when the vehicle is required to turn from the straight. If each front wheel is to roll it must follow its own arc; if it is to do this, a

line drawn through its hub—the projection of the axis through its hub—must pass through the centre of the turning circle which is situated somewhere on the centre line of the rear axle (Fig. 8). Thus the outer front wheel must be turned through a smaller angle than that of the inner one.

21. This condition is obtained accurately enough for practical purposes by the inclination of the two stub axle arms towards each other, so that if their centre lines were projected they would intersect on the centre line of the vehicle at a point on, or near, the centre of the rear axle (Fig. 8). By this means, all four wheels turn about a common centre, for, if the centre lines of the stub axles are projected at any point within the steering range, it will be found that they meet on the projected line of the rear axle, that is to say at the common centre of the turning circle of the vehicle. Fig. 9 illustrates the relative movement of the stub axles for the right and left lock positions.

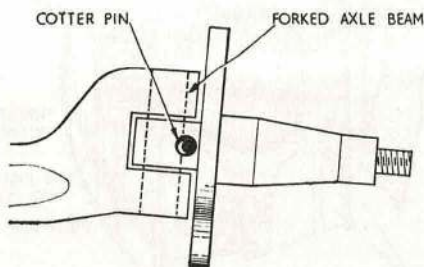


Fig. 6. ELLIOT STUB AXLE.

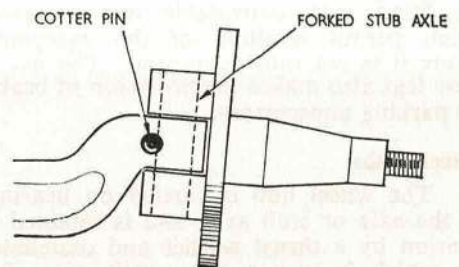


Fig. 7. REVERSED ELLIOT STUB AXLE.

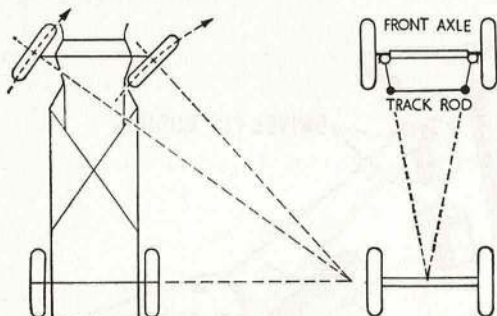


Fig. 8. ACKERMANN PRINCIPLE.

of the opposed taper roller type, and side play on the hub can be eliminated by adjustment of the castellated nut. The hub is packed with grease on assembly, and a seal is usually fitted, particularly when brakes are incorporated, to prevent the grease reaching the linings. Provision is sometimes made for the addition of lubricant through a grease nipple (Fig. 10).

Independent Suspension

24. Some of the more modern ground equipment trolleys are fitted with independent suspension. This term covers any arrange-

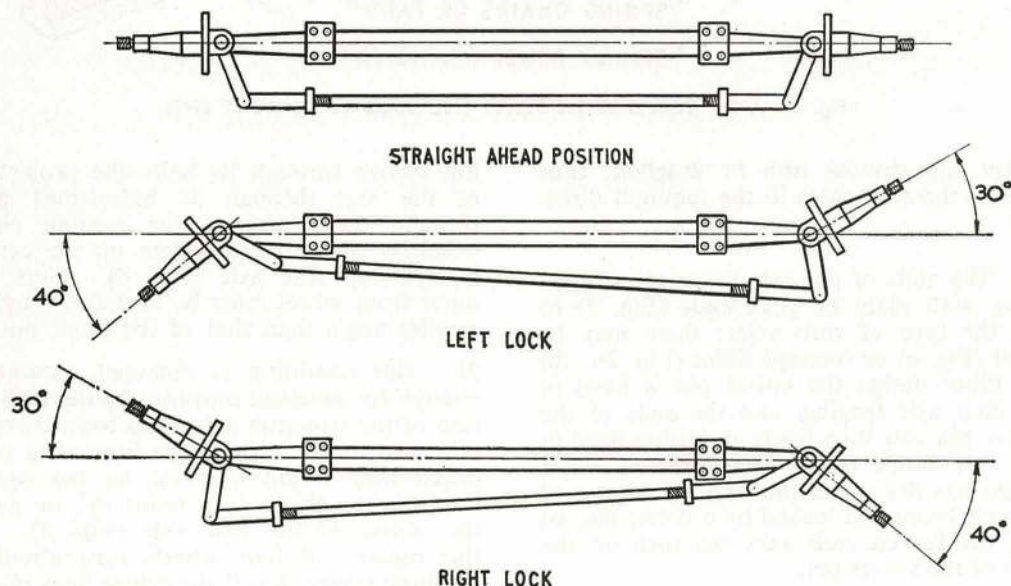


Fig. 9. RELATIVE MOVEMENT OF STUB AXLES.

Levelling

22. It is essential that many items of ground equipment should operate in a level position. To achieve this requirement and also to obtain stability, many two-wheeled trolleys are fitted with extendable legs or jacks which permit levelling of the equipment before it is put into operation. The use of these legs also makes the provision of brakes for parking unnecessary.

Wheel Hubs

23. The wheel hub is carried on bearings on the axle or stub axle, and is retained in position by a thrust washer and castellated nut which is locked by a split pin. The bearings on smaller trolleys may be plain bushes, but on the larger types they are usually

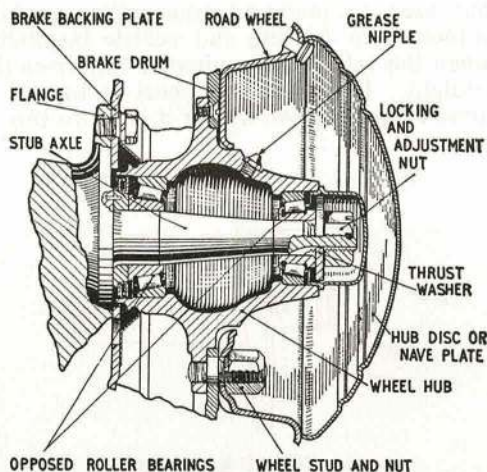


Fig. 10. WHEEL HUB AND STUB AXLE.

ment for connecting the wheels to the chassis in which the rise or fall of one wheel has no direct effect on the other wheels. With the orthodox axle arrangement, the rise of one wheel causes tilting of the whole vehicle and subjects the chassis to strain. When applied to a trolley, independent suspension will increase the stability and also enable the designer to keep the overall height of the equipment to a minimum.

25. Independent suspension can be arranged in many different ways, but it is beyond the scope of these notes to indicate all the possible combinations of type of suspension and type and position of spring; thus, the following is only a brief outline of a typical layout.

26. Instead of the normal transverse axle, two short stub axles are used. Each stub axle is mounted, by means of swivel pin, to a vertical member which is located between and attached to two swinging links. These links are commonly known as **wishbones**, and the upper one is usually shorter than the lower link. Springing is often afforded by means of a coil spring mounted between the lower link and a projecting pad on the chassis. An example of this type of independent suspension is shown at Fig. 11. Steering can be effected by dividing the

track rod at the centre where the end of the towbar is attached, and pivoting the towbar on a bracket attached to the chassis frame.

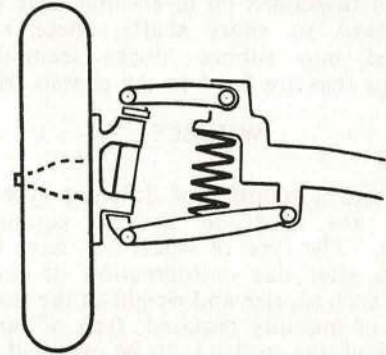


Fig. 11. INDEPENDENT SUSPENSION.

27. **Torsion Suspension.** This is another type of independent suspension, the principle of which is shown at Fig. 12. Torsion bar suspension has one torque shaft to each wheel, and is dependent for its action on the torque or twisting movement which is applied to a steel shaft by a lever or oscillating arm, on the other end of which the road wheel is mounted. Movement of the wheel causes the oscillating arm to impart

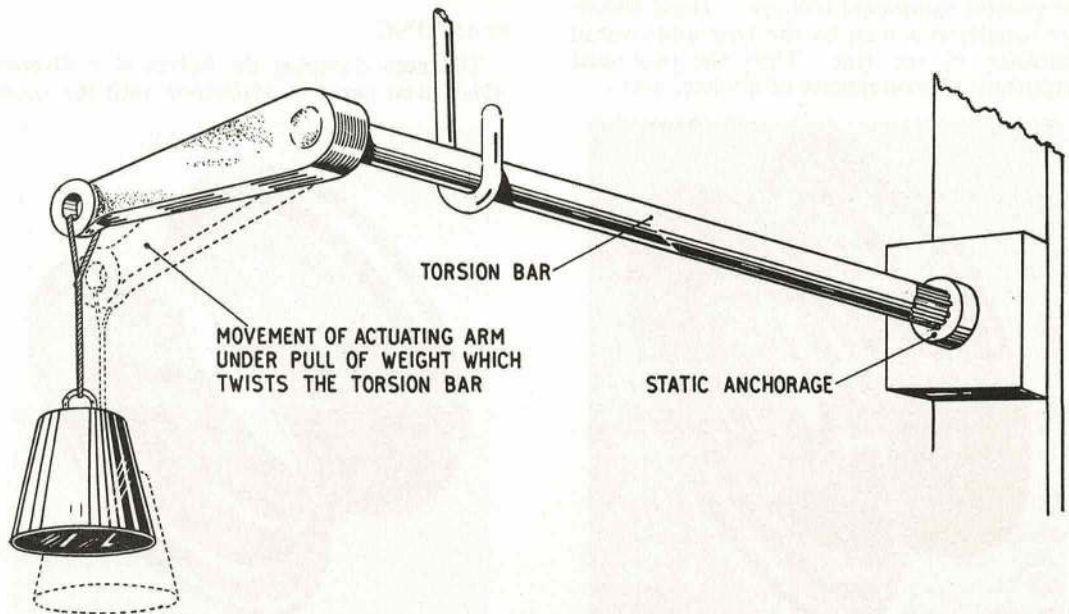


Fig. 12. TORSION BAR ACTION.

a twisting movement to the torque shaft, which is made of special steel to enable it to absorb such stresses. Another method uses "torsion rubbers". The axles in this case are suspended on levers that have their ends fixed to short shafts, these being moulded into rubber blocks secured in housings that are fixed to the chassis frame.

WHEELS

General

28. Quite a number of different types of wheels are used on ground equipment trolleys. The type of wheel will have been selected after due consideration of several factors such as, size and weight of the trolley, degree of mobility required, type of surface over which the trolley is to be operated, etc. The same type of trolley may be found in service to be fitted with solid wheels for a certain application, and with pneumatic tyres for another. On some simple trolleys solid wheels are still used, and these may be of cast iron, fabricated from steel sheet and welded, or even be made of hard moulded rubber.

29. A few wire-spoked wheels are still in use, but because of the wide use, with its inherent benefits, of the pneumatic tyre, disc wheels of the well-base and divided types are the main types of wheels now employed on ground equipment trolleys. These wheels are usually classified by the type and overall diameter of the rim. Thus the two most important measurements of a wheel are:—

(a) *Diameter of the wheel in inches.* This measurement is taken across the tyre bead seats, i.e. the diameter of that portion of the wheel on which the tyre fits.

(b) *The width between the rims in inches.* This measurement is taken across the rim from one bead seat to the other, i.e. the inner distance between the base of each flange of the wheel.

Well-Base Wheel

30. This type (Fig. 13) is virtually a one-piece wheel, because the rim pressing, incorporating both of the tyre retaining flanges, is either welded or riveted to the nave pressing. A well or recess around the centre of the rim facilitates the fitting and removal of the tyre.

Divided Wheel

31. This type of wheel (Fig. 14) is very widely used, and consists of two similar steel pressings each of which incorporates a nave and a half rim with a flange. The pressings are bolted together at the naves and thus form a wheel with two fixed flanges. With this type of wheel a chafer band is required to prevent the tube from being pinched in the joint between the two halves of the wheel. The tyre must be assembled complete with the tube and chafer band before the clamping bolts are inserted.

WARNING

The nuts clamping the halves of a divided wheel must never be slackened until the valve



Fig. 13. WELL-BASE WHEEL.



Fig. 14. DIVIDED WHEEL.

core has been removed and the tyre has been fully deflated. Similarly care must also be taken to ensure that ALL wheel bolts and nuts are fully secured before any attempt is made to inflate a tyre.

Servicing

32. Very little servicing is required for wheels of trolleys, but periodic examination is necessary to ensure that the wheels are not damaged and are running true, that there are no cracks developing particularly near the stud holes and, in the case of wire-spoked wheels, that none of the spokes are loose or broken. When tyres are removed from divided wheels it must be ensured that the nuts and bolts clamping the halves of the wheel together are serviceable.

33. Seepage of water between the tyre beads and wheel rims results in the tyre becoming corroded to the rim. Consequently, whenever tyres are removed from all types of wheels, the wheel rims must be thoroughly cleaned and all traces of rust removed; the rims must then be painted using paint, primer, red oxide of iron. Two coats are to be applied when sprayed, or one coat when brushed. The security of wheel nuts and, when fitted, nave plates, should be checked as detailed in the servicing schedule.

34. When fitting a wheel to a trolley, ensure that all the nuts are free on the threads of the studs. The nuts should then be screwed up lightly, making sure that their seatings register with the seatings in the wheel. Final tightening should be done progressively by short turns of opposite nuts.

TYRES

Introduction

35. The word "tyre" is commonly used when referring to the outer cover of a pneumatic tyre, but strictly speaking, the word "tyre" means both the outer cover and the inner tube. Although tubeless tyres, which are basically conventional outer covers fitted with an integral rubber lining, are now very widely used on road vehicles, the pneumatic tyre used on ground equipment at present, usually consists of an outer cover and a tube.

Outer Covers

36. The structure of all outer covers is very similar but may vary according to the duties

which particular covers are required to perform. Various materials are used in the construction of an outer cover, each material serving a definite purpose (Figs. 15 and 16).

37. **Beads.** The beads form the inside edges of the cover, each being built up on one or more coils of high tensile steel wire. These coils are secured in the upturned loops of the cord fabric plies and so form the central foundation of the main body or carcass of the cover. The wires are embedded in a hard rubber compound, wrapped in rubberized fabric, and are enclosed in the strips of canvas, known as "fillers", thus giving the necessary foundation on which the sidewalls can be blended into the beads. To protect the beads from damage, one or more layers of canvas called "chafers" are applied to the bead surfaces.

38. **Carcass.** The carcass or body of an outer cover consists mainly of several separate plies or layers of rubberized cords which have been built up to the required shape on the bead wire foundation. The rubberized cotton or rayon consists of cords run in one direction only, each cord being separated from its neighbour by a coating of rubber. Successive layers of rubberized cords, cut on the bias, are placed one upon the other so that each cord passes across the one below it at an angle of about 45 degrees. Other items incorporated in the carcass are the breakers and the cushions. The breakers consist of one or more layers of fabric placed between the tread and the carcass. Their purpose is to improve the adhesion between the carcass and the tread, and to assist the distribution of ground shocks so as to minimize their effect on the carcass. The cushions are layers of resilient rubber placed between the breakers for the purpose of absorbing road shocks and bonding the tread to the carcass.

39. **Tread.** This is the layer of rubber forming the wearing surface which contacts the ground. The thickness of the tread protects the plies from damage, and it is extended in the form of a thin rubber coating to form the sidewalls down to the beads. The hot plastic rubber used for tread manufacture is forced through a die in a machine, called an "extruder", which works on the principle of a mincing machine. The rubber emerges as the roughly-shaped tread and, after cooling, a length is cut and fitted over

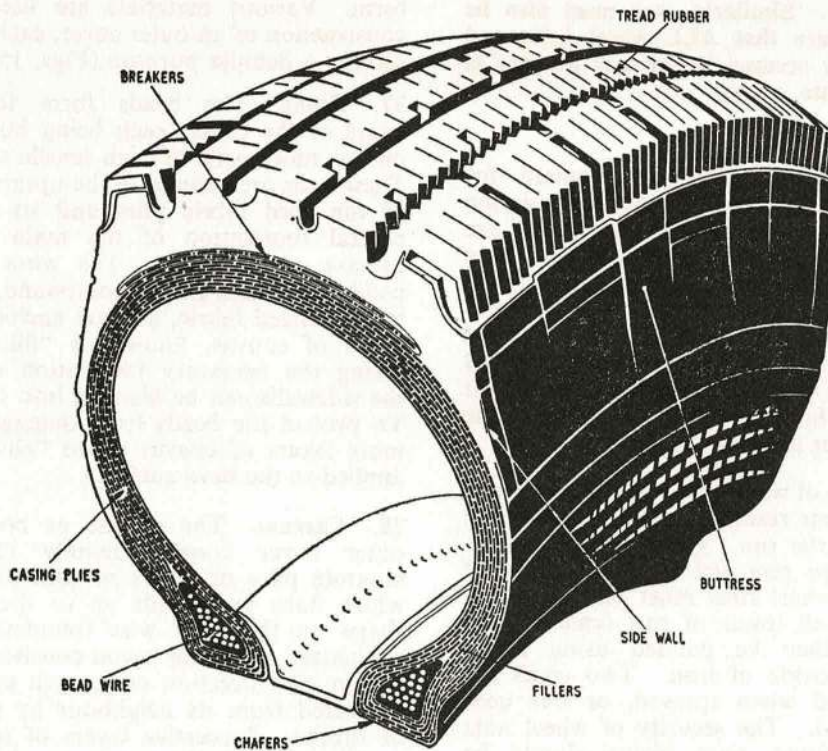


Fig. 15. CONSTRUCTIONAL DETAILS OF OUTER COVER (1).

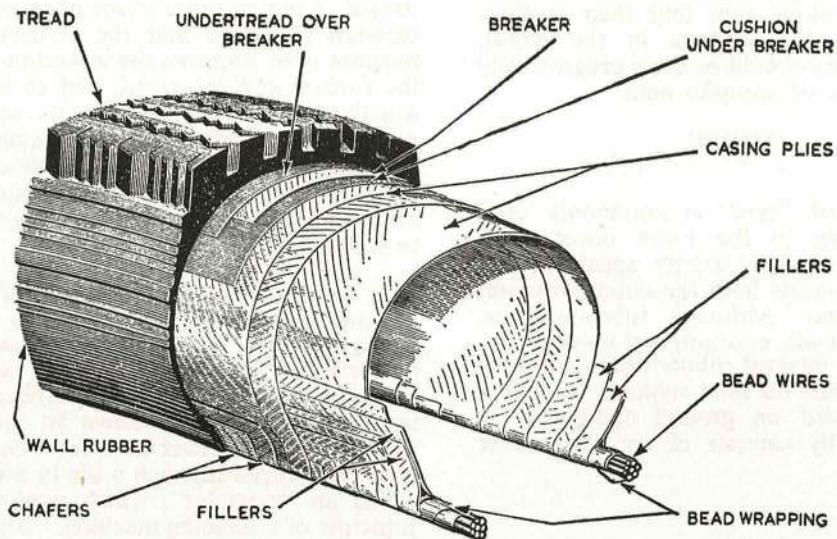


Fig. 16. CONSTRUCTIONAL DETAILS OF OUTER COVER (2).

a prepared carcass. The assembly is then placed in a mould where heat and pressure are applied, the tread being moulded to the required pattern and the cover vulcanized to the correct size and form.

Inner Tubes

40. The basic part of the manufacture of an inner tube is done by an extruding machine which forces a compound of hot rubber through a circular die, thus producing a continuous length of tubing. The requisite length, according to the size of tube required, is cut off; the ends are then butt welded and a valve is fitted. The tube is inflated and then moulded and vulcanized in a single process, so producing the finished tube to the required dimensions. A tube is designated by the dimensions of the outer cover in which it is to be used. These dimensions are marked on each tube and sometimes include an alternative size of cover in which the tube may be used.

41. A tube is inflated with air from an outside source through a simple non-return valve. Valves are made in various sizes and shapes to suit the different sizes and types of wheels, but the principle of operation is the same for all and is shown in the illustration (Fig. 17). The core may be removed by using either a slotted valve cap or a special slotted tool which is supplied. Always replace the valve cap after any attention to the valve, because this excludes dirt and also forms another seal to prevent the leakage of air.

Servicing

42. **General.** Tyres must be inspected and serviced regularly as detailed in the servicing schedule; tyre failure can frequently be attributed to neglect. Damaged or worn

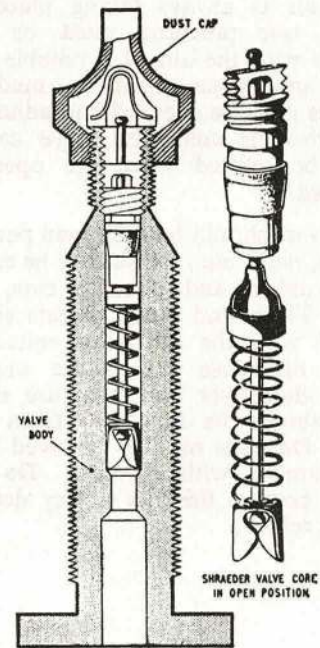


Fig. 17. TUBE VALVE.

covers and tubes must be removed immediately and either repaired or exchanged.

43. **Tyre Inflation.** Neglecting to keep tyres correctly inflated is one of the main causes of failure. Persistent under-inflation allows excessive flexing of the side walls and consequent fracture. The tread also takes a concave form, as shown in Fig. 18, and consequently the load is taken on the sides of the tread, causing them to wear rapidly and leaving the centre portion comparatively unworn. Persistent over-inflation causes the area of tread in contact with the ground to be reduced, and renders the cover more vulnerable to impact fractures. Slight leak-

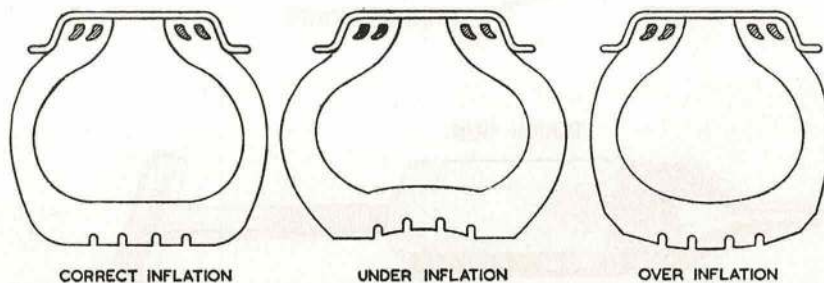


Fig. 18. TYRE INFLATION.

age of air is always taking place, consequently, tyre pressures must be checked regularly with the aid of a reliable pressure gauge; any losses must be made good. Pressures must be checked and adjusted only when tyres are cold, and valve caps must always be refitted when the operation is completed.

44. Covers should be examined periodically for flints, nails, etc., which may be embedded in the rubber, and also for cuts, oil and grease. Flints and sharp objects should be removed with the aid of a suitable tool, because otherwise the object may work through the cover and puncture the tube. Covers should be kept free from oil and grease. Deposits may be removed by using a rag damped with gasoline. **Do not use kerosine because this has a very detrimental effect on rubber.**

Outer Cover Repairs

45. **General.** When an outer cover is damaged on the tread, provided that such damage does not penetrate into the fabric plies, the Bowes Seal Fast Process can be used as the method of repair. The equipment which is supplied is shown in the illustration (Fig. 19), the dough gun being charged with plastic rubber. The success of the repair depends almost entirely on the cleanliness of the tools and of the hole or cut in the cover. The procedure is described in the following paragraphs.

46. **Preparation of Cover.** A cover should be examined for cuts or holes which require filling and these should be marked with chalk. The carcass should be checked thoroughly in the region of the abrasions to ensure that the cords have not been damaged.

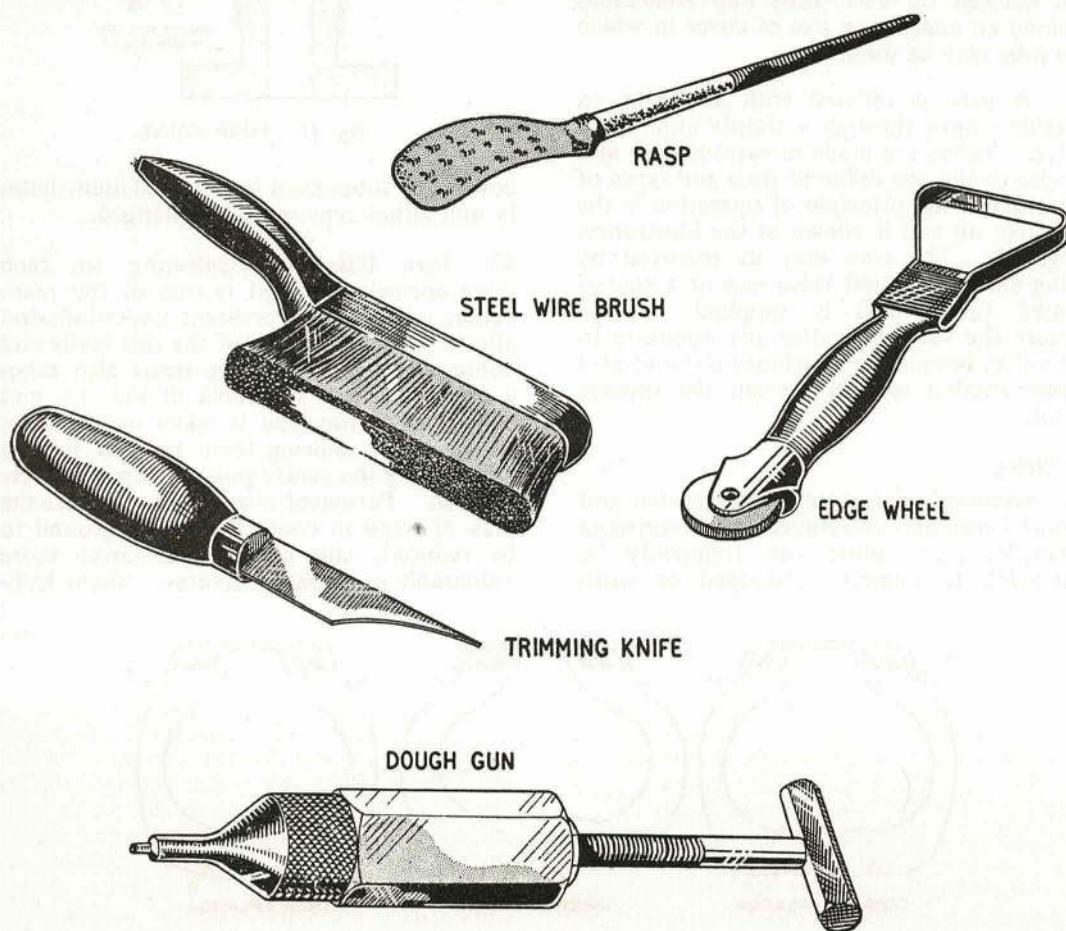


Fig. 19. BOWES SEAL FAST EQUIPMENT.

Repair by the following method should not be attempted if the carcass is found to be damaged. Each cut must be probed to ensure that it is free from such things as flints or nails. The repair operation will be facilitated if the cover is assembled on the wheel and inflated to its normal working pressure. To prepare a cut or hole for the application of the dough, proceed as follows:—

- (a) Trim off any loose rubber and bevel the edges of the cut or hole to 45 degrees.
- (b) Use the rasp to roughen the edges of the cut or hole.
- (c) Apply solvent to the roughened area and, whilst still wet, scrape the surface until it dries off. Use a clean rag when wiping the knife.

Note. After the scraping is complete the prepared surface must not be touched in any way.

47. Preparation of Gun. The dough gun is filled in the following manner:—

- (a) Unscrew the plunger as far as is possible.
- (b) Unscrew the nozzle of the gun.
- (c) Remove the paper covering from a cartridge of dough and insert the cartridge, open end first, into the nozzle.
- (d) Screw the nozzle on to the barrel of the gun. The gun is now ready for use.

Note. To charge the gun after it has been used, first unscrew the nozzle and remove the old cartridge.

48. Application of Dough. Use the gun to force a thick layer of dough into the cut or hole, and then use a clean hammer to hammer this layer well in. Allow thirty minutes for this layer to dry, after which it must be rolled down with the edge wheel and again hammered. Apply successive layers in the same way until the dough is brought up to the level of the surrounding area. As each application of the dough is made, a small pip of dough should be left on the tip of the nozzle to act as a seal; this pip should be broken off immediately before the gun is to be used again. If the repair is inadvertently soiled during these operations, it must be painted over with solvent and scraped quickly before applying any more dough.

- Notes.*
1. The cleaning solvent is highly volatile and so the container cap must be kept tightly in position when the solvent is not being used.
 2. Gasoline must not be used instead of the solvent.
 3. The charged gun and cartridges must be kept in a temperate place or otherwise the dough will become dry and useless.

49. The cover should not be put into service until approximately eight hours after the completion of the repair, but this period may be varied according to the depth of the filling and the existing atmospheric conditions; if conditions are favourable the period may be reduced to four hours. If, after repair, a cover has to be used prematurely, the repair must be examined as soon as possible to see if there is any loosening of the dough.

Inner Tube Repairs

50. General. To locate a leak in an inner tube, the tube should be inflated and immersed in a tank containing water; escaping air will be seen in the form of bubbles. The repair will normally be done with the aid of vulcanizing equipment but, if such equipment is not available, the use of a cold patch and solution is permissible.

51. A Stenor vulcanizing machine (Fig. 20) is used for repairing damaged inner tubes. Prepared patches are supplied which can be vulcanized to the tube by heat and pressure, but damage beyond the limit of one patch must not be repaired by overlapping patches. The heat is obtained from an electric element enclosed by the sole plate casing, and is automatically controlled by a fuse which "blows" when the required temperature is reached; a new fuse is required therefore for each vulcanizing operation. Repair procedure is described in the following paragraphs.

52. Using sharp scissors, trim the damaged part so as to prevent any extension of the slit. Select a suitable patch (heavy-duty for thick tubes), and thoroughly clean the area on the tube which will be covered by it. Using a wire brush, carefully roughen the cleaned surface of the tube. With heavy-duty tubes, press the edges of the hole together and bevel them by rubbing with the

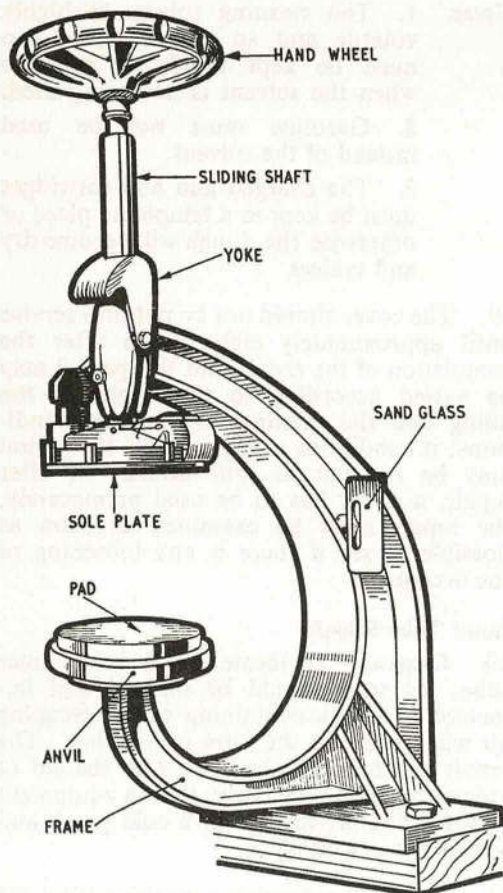


Fig. 20. STENOR VULCANIZER.

wire brush. The cleaned area of the tube should not be fingered. Place the tube on the machine with the part to be repaired positioned centrally on the rubber pad. Take the patch, but not the fuse, out of the packet; remove the protective linen from the flat surface of the patch and press the patch, domed surface uppermost, centrally over the hole in the tube. Turn the hand wheel until the sole plate is clamped firmly down on to the tube as shown in Fig. 21, taking care to ensure that the patch is fully covered and that the doubled edge of the tube is not nipped under the sole plate.

53. Pass the fuse horizontally through the slot and, after it has dropped, slowly depress the trigger lever at the side of the sole plate (Fig. 22) until the fuse engages the switch. If a fuse fails to position itself correctly in the switch, it must be manoeuvred through

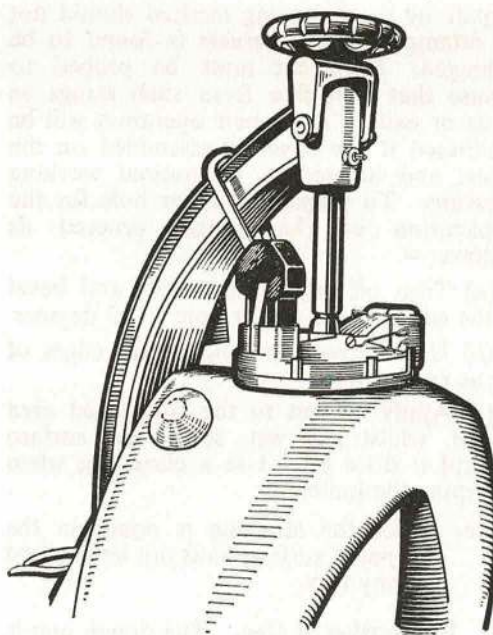


Fig. 21. TUBE IN POSITION FOR VULCANIZING.

one of the outlets and re-inserted. Do not allow unused fuses to remain inside the casing.

54. Switch on the mains current. After 4-6 minutes the fuse will be heard to blow. Switch off the mains current and remove the adapter plug from the machine. Curing of the repair takes place during the cooling period which is timed by using the sand glass.

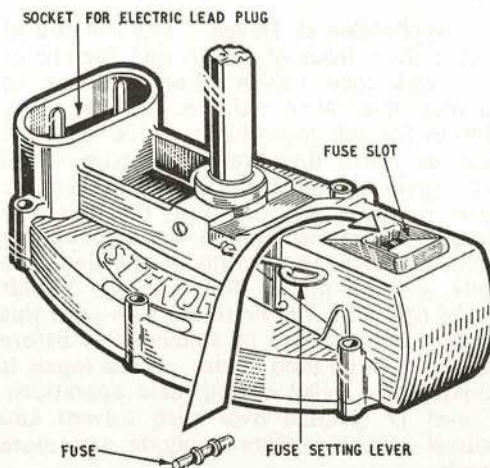


Fig. 22. SOLE PLATE AND FUSE.

The sand should be allowed to run through once for ordinary tubes and twice for heavy-duty tubes. The tube may then be taken off the machine but it should not be inflated or subjected to any strain until the repaired part is cold.

55. When a tube with a metal valve is damaged near the valve seating, it is generally advisable to remove the seating and repair the hole and damage as described in paras. 52-54. A new hole should then be cut in line with the old one and the valve stem pushed right inside the tube. The next step is to clean and roughen the area around the hole. Obtain a new valve seating, remove the protective linen from the back but do not remove the disc from under the seating. Place the seating centrally over the hole and vulcanize in the same manner as for a repair, but allow at least 15 minutes to cure after the fuse has blown. Remove the disc and manoeuvre the valve through the hole; fit and tighten the nut.

56. If the tube has a rubber-based valve, the new hole must be cut six inches away from and in line with the original valve.

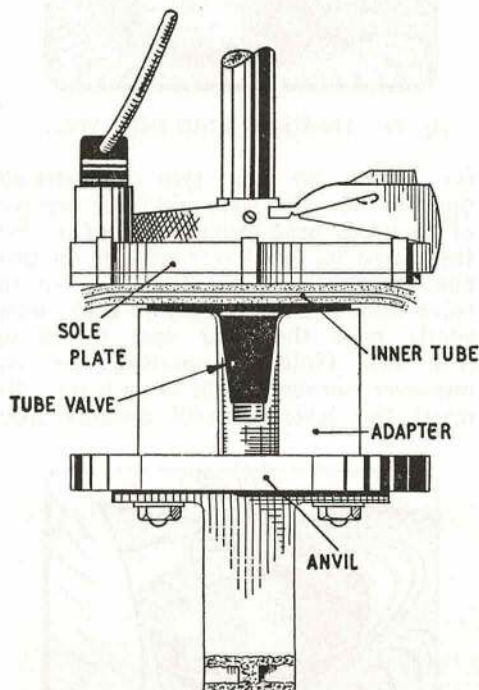


Fig. 23. METHOD OF VULCANIZING RUBBER-BASED VALVES.

Clean and roughen the area around the hole. Obtain a new valve, remove the protective linen from its seating and apply Stenor solution to the valve base. Remove the rubber pad from the anvil, place the valve centrally over the hole in the tube, and position the valve stem in the special adapter which should be placed with its concave end upwards in the recess of the anvil. Ensure that the folds of the tube are clear of the adapter. Vulcanize through the tube as shown in Fig. 23, using the two fuses supplied with the valve. When the first fuse has blown, allow at least 5 minutes before inserting the second fuse. When the second fuse blows, allow 15 minutes curing time before removing the tube from the machine.

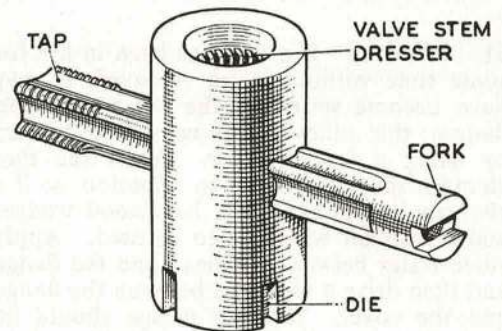


Fig. 24. VALVE REPAIR TOOL.

57. Superficial damage to the valve tip or to the threads of the valve stem can be rectified by using the repair tool shown in Fig. 24.

58. At all times after repair and whenever a new tube is fitted, it should first be dusted thoroughly with french chalk.

Servicing Precaution

59. **Tyre Inflation Guard.** To conform to H.M. Factory Inspectorate requirements for the prevention of accidents which may occur during the inflation of tyres fitted on **divided wheels** and **detachable flange wheels**, a tyre inflation guard (cage) must be used in all tyre servicing bays.

Tyre Removal and Fitting

60. **General.** It is essential that the correct procedure should be employed when removing and fitting tyres; otherwise, covers, tubes or rims may be damaged, personnel may be injured, and much time and energy

may be wasted. It is beyond the scope of these notes to describe all the procedures and equipment for the different types of wheels and covers, therefore, the well-base type will be detailed as an example. The equipment which may be available consists of an assortment of tyre levers, a tyre spreader and some wooden distance pieces, a fixed or a portable tyre changer, and a hydraulic tyre changer. When a tyre changer is not available the following items will also be required.

- (a) A block of wood which is slightly less in diameter than that of the wheel rim, and of such a height that the tyre will be about three inches from the ground when the wheel is laid upon the block.
- (b) Some hardwood wedges.

61. Removal. If a tyre has been in use for some time without being removed, it may have become seized to the wheel rim and flanges; this adhesion can usually be broken by using a tyre changer. When the tyre changer fails to break the adhesion or if a changer is not available, hardwood wedges and a hammer will have to be used. Apply some water between the bead and the flange and then drive a wedge in between the flange and the cover. Another wedge should be held adjacent to the first one and driven into place. The first wedge can then be removed, and alternate use of the wedges should be repeated around the wheel until the bead is released from the rim.

62. Fitting. Before starting to fit a cover on a wheel, all rust and dirt must be removed from the rim and preservative paint applied (para. 33). The tube, the chafer band (if fitted) and the inside of the cover should be cleaned and the tube dusted with french chalk. The wheel should be examined for defects and the appropriate remedial action taken. An inner tube should be inflated slightly when fitted; this will help to eliminate creases and also avoid pinching of the tube by tyre levers. When fitted, the edges of a chafer band must not be wrinkled or folded, and the valve must be positioned in the hole in the rim without any strain.

Notes. 1. Removal and fitting operations will be facilitated if the cover beads are lubricated liberally with water, or preferably, a soapy solution. Tyre levers should be dipped in water or soapy water each time before

being inserted between the cover and the rim.

2. Balance markings for assembly purposes may be noted on the cover and inner tube. These are important when the covers and tubes are used on road transport vehicles.

Well-Base Wheels

63. Removal. To remove a tyre from a wheel, proceed as follows:—

- (a) Deflate the inner tube and remove the valve core.
- (b) Lay the wheel on the ground and loosen both beads from the rim by treading around the tyre (Fig. 25). If the bead is welded to the rim, use a hammer and hardwood wedges (para. 60). Always release both beads from the rim seating before attempting to remove the cover from the rim.



Fig. 25. TREADING BEAD INTO WELL.

- (c) Kneel on the tyre diametrically opposite the valve stem and force that part of the upper bead into the well of the rim. Insert two flat tyre levers between the bead and the rim, one on either side of the valve stem and fairly near to each other; gently prise the bead over the flange (Fig. 26). Hold the removed part with one lever and remove the other lever. Reinsert this lever a small distance away



Fig. 26. USING TYRE LEVERS.

from the other and gently prise the bead again over the flange. Continue working in small steps without using undue force, using both levers alternately on either side of the valve stem until the complete bead is clear of the rim.

(d) Push the valve stem through the hole in the wheel and remove the inner tube, starting opposite the valve. Never pull on the valve to remove the tube.

(e) Stand the wheel upright, and push the bottom part of the bead which remains on the rim into the well. Insert a lever between the top part of the bead and the flange and, as the bead is eased over the flange, push the wheel out of the cover (Fig. 27). If difficulty is experienced, maintain pressure on the lever and use a rubber mallet to tap the bead where it passes over the top of the flange.

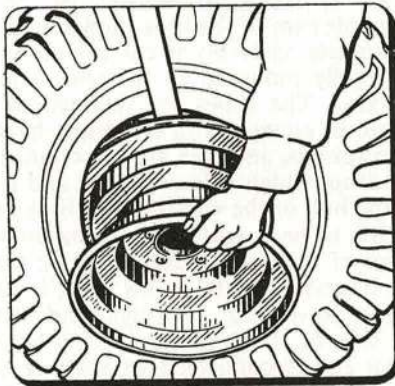


Fig. 27. REMOVING TYRE FROM WHEEL.

64. **Fitting.** To assemble a tyre on a wheel, proceed as follows:—

(a) Place the tube into the cover and inflate until it is just rounded; seal by the valve cap only. Stand cover and tube upright with the valve at the bottom.

(b) Slide the rim into the cover and insert the valve into the hole in the rim. With the cover still upright, push the rim well down into the cover and lever the bead onto the rim. Take small bites with the lever and use plenty of water as a lubricant.

(c) Place the wheel on the ground and ensure that the valve is located correctly in the valve hole. Push the bead opposite the valve into the well and release the air

pressure from the tube. Starting at the valve and taking small bites, lever the bead over the flange alternately either side of the valve; use plenty of water as a lubricant.

(d) Replace the valve core and push the valve inwards to check that the tube near the valve is not trapped under the bead. Pull the valve back into position and, during inflation, check that the valve protrudes squarely from the rim; if it does not, deflate the tube and adjust the position of the cover and tube on the rim.

(e) Inflate the tube. Check that the beads are seated properly, and that the fitting line on the cover is concentric with the top of the flange.

(f) Deflate the tube by removing the valve core, taking care not to disturb the cover beads. Replace the valve core, inflate the tube to the recommended working pressure and screw on the valve cap.

Note. The reasons for dual inflation are that it obviates local stretching which occurs on the base of the tube when the beads are being pushed up to the flanges during initial inflation, and that it also removes any creases which may have been made in the tube during initial inflation of the tyre.

BRAKES

General

65. If trolleys are to be really mobile, it is obvious that brakes are required to maintain control during towing operations and also when being manoeuvred by hand. The same brakes can also be applied by means of a parking device to prevent any tendency of the trolley to move when it is stationary but with the equipment in operation. Furthermore, if a trolley is likely to be towed on a public highway then it will have been designed to conform to the necessary requirements; for example, if it is above a certain weight then it must be fitted with over-ride brakes at least.

66. Some trolleys, depending on their size and usage, are not fitted with brakes. Others have a simple system that is often operated by hand, whilst many have a proper system operated by over-ride action when being towed and by hand operation for parking

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purposes. A few very large and heavy trolleys use air pressure for brake operation. Braking may be carried out on the wheels of both axles, or on the wheels of either the front or rear axle only. There are a few examples of other types of brakes in use but most brakes on ground equipment trolleys are of the internal expanding shoe type.

Internal Expanding Brakes

67. Internal expanding brakes (Fig. 28) comprise two shoes lined with friction material which are mounted on the brake backplate. The shoes are fitted within a flanged drum, and are opened or expanded at one end by an expander unit which may be a form of mechanically operated cam or a hydraulic cylinder. They are pivoted at the other end on a pivot pin or pins which are often referred to as anchor pins. With the brakes in the "off" position, the drum is free to revolve with the wheel and hub, as its internal diameter is greater than the overall diameter of the brake shoes. As the brakes are operated the expander pushes apart the ends of the shoes, causing the friction lining material on the faces of the shoes to contact the revolving drum.

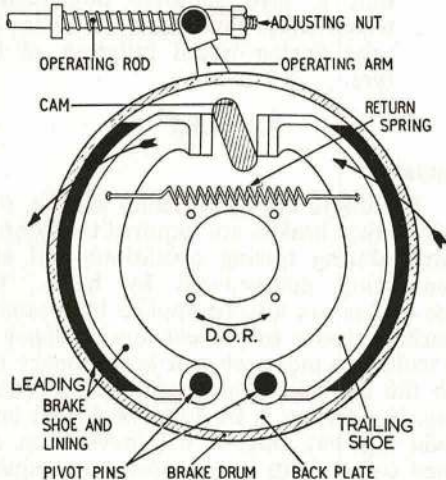


Fig. 28. INTERNAL EXPANDING BRAKE UNIT.

68. If the direction of rotation is taken to be anti-clockwise, as in Fig. 28, then the left-hand shoe, which is in front of the expander, tends to be carried round by the revolving drum and, because it is pivoted on the anchor pin, it will therefore be pushed harder into contact with the drum. This effect is known as self-wrapping action and

the shoe is termed a primary or leading shoe. The right-hand shoe, however, is moved away from the brake drum as it pivots on the anchor pin, and this reduces the frictional force on the shoe. The shoe tends to unwrap and is termed a secondary or trailing shoe.

69. Due to the self-wrapping effect of the leading shoe and the unwrapping of the trailing shoe, the braking effect of the leading shoe is more than three times that of the trailing shoe. When necessary, various methods are employed to give the trailing shoe a leading shoe action and so increase the braking effect for a given effort at the expander; such examples are known as two leading shoe brakes.

Simple Cam-Operated Type

70. On this type of brake unit the two brake shoes are mounted at one end on a pivot or anchor pin, and their other ends have flat faces which bear against the sides of a double cam of the type shown in Fig. 28; the complete assembly is carried on a backplate rigidly mounted to the axle casing or stub axle. The shoes are retained in position, out of contact with the drum, by strong tension springs, and they are surrounded by a brake drum which is fastened to, and rotates with, the hub of the wheel. The brake shoes are made to bear against the drum by partial rotation of the double cam fitted on the end of the operating shaft. This shaft is carried in phosphor-bronze bearings and extends either side of the backplate. A lever on its external end is connected by rods or cables to whatever method of control is fitted, and a compensating device may be incorporated in the layout to ensure an even distribution of the braking effort to all of the wheels. A minimum clearance between shoes and drum in the "off" position allows the drum and hub to rotate freely.

71. A disadvantage of this type of brake is that leverage is lost as wear takes place. This can be counteracted by adjusting the lever to a more efficient position, or else by fitting packing plates of the requisite thickness between the ends of the shoes and the cam.

Girling Brakes

72. **General.** This is a mechanical type of brake, self-centring, and having a special adjuster and expander mechanism (Fig. 29). It is mechanically simple and efficient due to the method of expanding the shoes and the

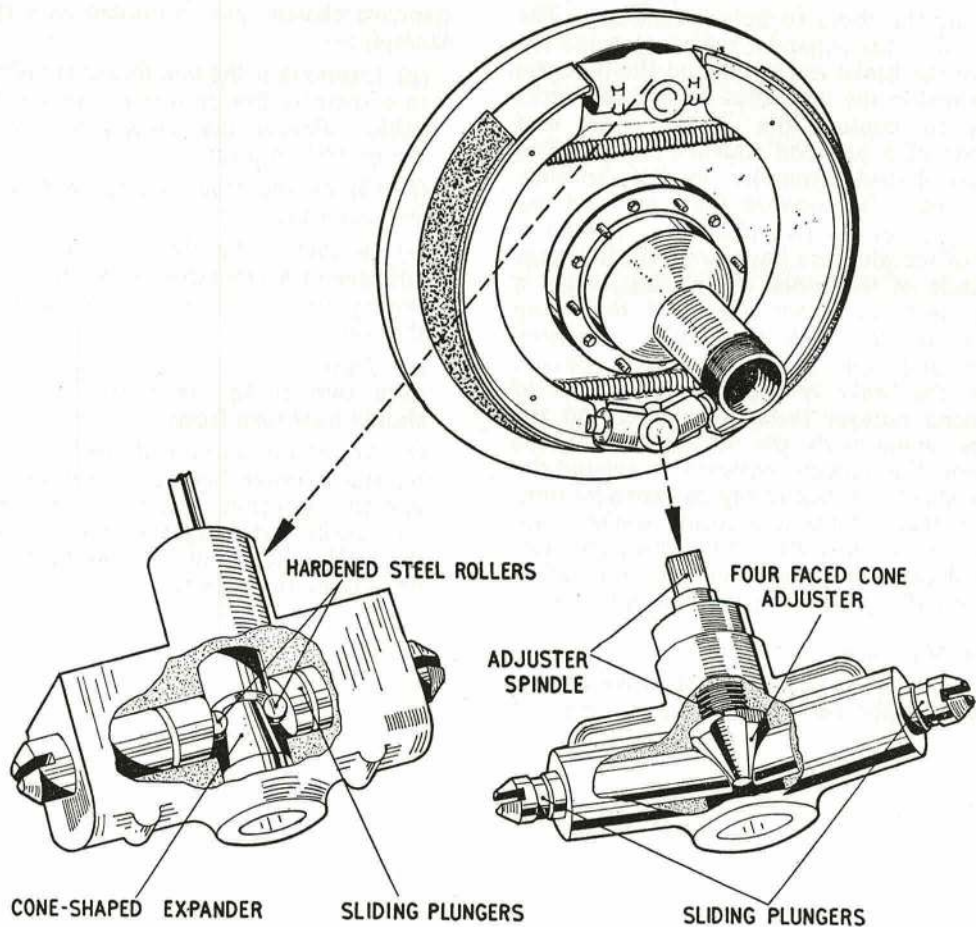


Fig. 29. GIRLING BRAKE ASSEMBLY.

straight pull of the expander. Lost motion and friction are at a minimum, and the effort is multiplied (approximately) six times. All the brake rods are in tension but only lightly loaded, and it is usual to incorporate a compensating device in the layout. The adjustment provided is so designed that it repositions the shoes slightly and gives a bigger lining contact than the normal type of adjustment. Another important feature is that jacking up is not necessary in order to carry out brake adjustment.

73. The Adjuster. The adjuster unit is attached to the steel backplate and forms the anchorage or fixed fulcrum point for the brake shoes. The housing contains a threaded spindle having a squared external boss; this provides for a spanner to be used to turn the spindle in the housing and thus

to reposition the brake shoes. The inner end of the spindle is cone-shaped and has machined, case-hardened flats. Two flats of the cone (opposite each other) support the inner ends of two sliding plungers which are contained in the housing. The outer ends of the plungers are slotted and carry one end of each brake shoe. The plungers are set at right-angles to the cone flats, thus, when the spindle is turned for adjustment purposes, the plungers move obliquely to or from the spindle centre line. This action repositions the brake shoes in the drum with the curvature of the brake shoe linings remaining true to that of the drum, so maintaining maximum braking surface.

74. The Expander. The expander unit is held under light spring-pressure in slots in the backplate, a limited amount of float

allowing the shoes to be self-centring. The function of the expander unit is to cause the pull of the brake rod to expand the plungers contained in the unit, thus forcing the brake shoes to contact the drum. Each unit consists of a pull rod which is connected to a cone-shaped expander in the housing. Two rollers lie between the cone and the inner ends of the two plungers. The outer ends of the plungers have slots which engage the ends of the brake shoes, thus, when a complete brake unit is assembled, the strong return springs hold the shoes, plungers, rollers and cone together in close contact. When the brake is operated, movement of the cone plunger forces the rollers up the wedge made with the tappet faces, thus pushing the tappets outward to expand the brake shoes. When fitting an expander unit, ensure that double coil spring washers are fitted under the nuts; first tighten the nuts then slacken them one complete turn before finally locking each nut with a split pin.

Brake Adjustment

75. The following method of brake adjustment is applicable to the 35 cwt., mark 2

standard chassis, and is quoted as a typical example:—

- (a) Ensure that the handbrake is "off" and that there is free movement in the brake cable. Slacken the cable, if necessary, at the central adjuster.
- (b) Chock the front wheels and jack up the rear wheels.
- (c) On each brake drum in turn, screw the adjuster in a clockwise direction until the brakes are on. Check by trying to turn the wheels.
- (d) Turn back the adjuster on each drum until two clicks are heard; the wheels should now turn freely.
- (e) Adjust the tension of the brake cable, on the adjuster between the brake cable and the operating rod, to ensure that the handbrake pawl engages at the centre of the ratchet quadrant with the brakes hard on. Lock the adjuster.

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