# Chapter 1

*(Text completely revised)*

# CLASSIFICATION OF DAMAGE TO AIRCRAFT TYRES AND TUBES

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



## LIST OF TABLES

## General

1. This chapter contains information to guide personnel in the classification for repair of defective aircraft tyres and tubes. The classification of normal tread wear is given in Vol. 1, Book 2, Sect. 2, Chap. 2, and instructions on the recording of the history of the tyre will be found in Vol. 2, Leaflet B.3. The summarized information in Table 1 is also issued in A.D.4586.

## TYRES

### Examination

2. Whenever tyres are removed from their wheels, they must be examined for tread cuts and splits, for chafing of the beads, for fractures on the inside of the casing caused by cuts or concussion, and for the lifting or movement of any tyre material.

3. The interior examination of a large tyre can be facilitated by rolling it along the floor and observing the area that is flattened by contact with the ground; the fractures are thereby opened and thus are more easily discernible.

### Classification for repair

4. Defective aircraft tyres may be (a) repairable at Unit, (b) repairable at factory, or (c) unrepairable (i.e. scrap). Various types of damage, together with their possible causes and appropriate disposal or repair instructions, are listed in Table 1 against the figure numbers that illustrate them.

**Table 1**

**Classification for repair of defective aircraft tyres**

| Fig. No. | Types of damage | Possible cause | Disposal or repair instructions | |
|---|---|---|---|---|
| | | | Applicability | Category |
| 1 | Scuff | Locked wheel | (a) Tyres up to 100 lb/in² | Factory |
| | | | (b) Tyres over 100 lb/in² | Scrap |
| 2 | Flat spot, scald or skid burn | Locked wheel | (a) Tread pattern remains | Serviceable |
| | | | (b) Tread pattern worn away | Factory |
| | | | (c) Casing cords damaged | Scrap |
| 3 | Uneven tread wear | Incorrect pressure or misalignment | (a) Tread pattern remains | Serviceable |
| | | | (b) Tread pattern worn away | Factory |
| | | | (c) Worn on one side | Serviceable when tyre has been turned round on wheel |
| 4 | Tread rubber cut or nail hole in casing (para. 6) | Flints and nails | (a) Tyres up to 100 lb/in² | Unit |
| | | | (b) Tyres over 100 lb/in² | Factory |
| 5 | Split in base of tread groove | Extension of cut by swivelling of aircraft | (a) Splits under 2 in. long, not more than two, at least 12 in. apart, in tyres up to 100 lb/in² | Unit |
| | | | (b) Tyres over 100 lb/in², and splits over above limits | Factory |
| 6 | Open tread joint | Moulding defect | All tyres | Factory |
| 7 | Tread fully worn | Normal wear | (a) Tyres up to 300 lb/in² | Factory |
| | | | (b) Tyres over 300 lb/in² | Scrap |
| 8 | Local swelling of rubber | Oil contamination | All tyres | Scrap |
| 9 | Fracture of casing cords | Impact on small area | All tyres | Scrap |

**TABLE 1** (*continued*)

| Fig. No. | Types of damage | Possible cause | Disposal or repair instructions | |
|---|---|---|---|---|
| | | | Applicability | Category |
| 10 | Blistering | Air trapped between outer cord ply and outer rubber | (a) Not more than two blisters, up to 1 in. diameter, in lower sidewall only (i.e. not above size marking), and not less than 1 ft. apart whether on one or both sides of the tyre | Serviceable after the blisters have been punctured with an awl to release the trapped air |
| | | | (b) Sidewall blister up to $1\frac{1}{2}$ in. diameter | Factory |
| | | | (c) Sidewall blister over $1\frac{1}{2}$ in. diameter | Scrap |
| 11 | Cracks in sidewall | Ageing, prolonged exposure, or faulty storage | (a) Cords not exposed | Serviceable |
| | | | (b) Cords exposed | Factory |
| 12 | Sidewall flow splits | Moulding defect | (a) Cords not exposed | Servicable |
| | | | (b) Cords exposed | Factory |
| 13 | Loaded while deflated | Loss of air | Damaged and apparently undamaged | Scrap |
| 14 | Rim chafing | Under-inflation or oil contamination | (a) Chafer cords undamaged | Serviceable |
| | | | (b) Chafer cords damaged | Factory |
| 15 | Tyre lever damage | Incorrect use of levers | (a) Chafer cords undamaged | Serviceable |
| | | | (b) Chafer cords damaged | Factory |
| | | | (c) Cords below chafer damaged | Scrap |
| — | Inner liner damage (tubeless tyres only) | Impact on small area or oil contamination | (a) Nail holes | Serviceable |
| | | | (b) Any other damage | Scrap |
| — | Structural damage from over-heating | Excessive brake temperatures | All tyres on wheels with fusible plugs that have melted | Scrap |
| — | Loose or lifting balance rubber | Manufacturing defect | All tyres | Serviceable when rubber has been secured |

**Limits of Unit repairs**

**5.** The extent of repair that may be carried out at a Unit is generally restricted to repair of the tread rubber only. Where there would be a large number of such repairs, however, it is generally more economical to return the tyre to the factory for remoulding.

**6.** The repair categories for tyres with isolated cuts in the tread area are shown in Table 2 against various tyre pressure limitations.

**7.** Unit repair must not be attempted when the cord fabric of the tyre is damaged, except

in emergency (para. 8) or when the damage has been caused by a nail or similar object. Nail holes are defined as clear penetrations of $\frac{1}{16}$ in. diameter or less, through any or all of the casing plies.

**Emergency repairs**

**8.** If an aircraft has tyres with cuts that are not confined to the rubber but penetrate the casing, it may return to base for renewal of the tyres provided that the conditions given in para. 9, 10 and 11 are met; the conditions are applicable to both single-tyred and multi-tyred undercarriages.

**9.** The concession is only permissible for those tyres (a) with inflation pressures that do not exceed 300 lb/in$^2$ and (b) with casing cuts that are confined to the tread area. Any cuts in the sidewall cords render the tyre unrepairable (scrap) and it must be renewed before the aircraft is flown.

**10.** The concessionary cuts must not penetrate more than the two top cord layers, and may not be more than $\frac{1}{2}$ in. long in the top cord layer. Further, the cuts must not be more than two in number and must be at least one foot apart around the circumference.

**11.** Before the aircraft returns to base, the cuts must be plugged with repair compound as stated in Chapter 3, and the tyre suitably marked to show the positions of the cuts when it arrives at base for repair classification.

**Unrepairable tyres**

**12.** Tyres that cannot be repaired must be marked SCRAP, in large white-painted letters, on both sidewalls; all other markings, except those giving tyre size, must be buffed off before disposal.

## TUBES

**Examination**

**13.** Whenever tyres are removed from their wheels, their tubes must be examined for damage. Any damage to a tube should, where possible, be correlated with the corresponding damage to the tyre as this may not be readily apparent.

**14.** The valve should be examined for defective threads, and the core renewed. The reinforcing collar around the valve (A in fig. 17) sometimes appears to have separated from the valve stem but this is not detrimental unless leakage is evident at this point.

**15.** The base of the tube should be examined all round for thinning of the rubber caused by heat generated during normal braking operations; this thinning may be felt at the part of the tube that has been adjacent to the bead toes.

**Limits of Unit repairs**

**16.** Unit repairs to the tube rubber (Chap. 3) are permissible for damage that is less than 2 in. × 2 in. in area, provided that the reinforcement at the valve will not be affected by the repair; if it will, the tube must be scrapped. Damaged valve threads may be rectified with a valve tool.

**Unrepairable tubes**

**17.** Any damage other than that stated in para. 16—such as excessive creasing (slight creasing is serviceable), tube thinning or stretching, or excessive bead toe chafing (fig. 16) or splitting—renders the tube scrap.

**TABLE 2**

**Repair categories for tyres with tread cuts**

| Tyre pressure (lb/in$^2$) | Cuts in tread area: Rubber only | Cuts in tread area: Rubber and casing | Remarks |
|---|---|---|---|
| Under 100 | Unit | Nail holes only—Unit | Emergency repairs (para. 8 to 11) |
| 100 to 200 | Factory | Cuts other than nail holes—Factory | |
| 200 to 300 | Factory | Scrap | |
| Over 300 | Factory | Scrap | |

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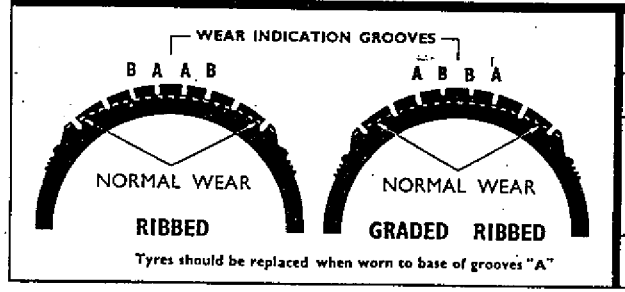
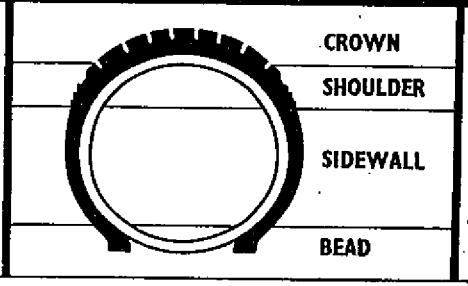
| REF | DESCRIPTION OF DAMAGE | POSSIBLE CAUSE | DISPOSAL |
|---|---|---|---|
| 1 | **SCUFFED** Localised wear resulting in abrasive damage to the tread casing | Wheel locking due to harsh braking | Factory when length of scuff does not exceed 1½ in. Beyond this scrap |
| 2 | **FLATSPOT** Localised wear of tread rubber only | A less severe form of the above | Factory |
| 3 | **UNEVEN TREAD WEAR** Excessive circumferential wear on any part of the tread profile | Misalignment, camber or incorrect inflation pressure | Factory |
| 4 | **TREAD CUT DAMAGE** Penetration of tread and casing by sharp object | Flints, nails, etc. | Repairable at Unit unless cuts are numerous or tyre is within limits given in **WARNING** |
| 5 | **SPLITTING IN BASE OF GROOVE** Circumferential split running in and parallel to pattern groove | Extension of a cut or swivelling of aircraft | Factory |
| 6 | **OPEN TREAD JOIN** Separation of tread at the join as distinct from a visible tread join | Inadequate knitting of tread joint surfaces during moulding | Factory |
| 7 | **COVER WORN OUT** | Service life of cover expended | Factory repair or scrap according to classification in A.P. 2337, Vol. 1, Book 2, Sect. 2, Chap. 2. |
| 8 | **CONTAMINATION** Localised swelling and softening of tread or wall rubber | Absorption of hydraulic fluids, oils, kerosine, etc. | Factory |
| 9 | **CONCUSSION FAILURE** Fracture of casing cords | Impact on objects | Scrap |
| 10 | **AIR TRAPPING** Tread blistering or bulging of sidewall or tread rubber | Air percolation or air trapping between tube and tyre during fitting. (Refer to correct inflation procedure) | Factory |
| 11 | **SIDEWALL CRACKING** Sidewall surface covered by a mass of small radial or circumferential cracks | Ageing, prolonged exposure to the weather. Incorrect storage | Examination as detailed in A.P. 2337 |
| 12 | **SIDEWALL SPLITS** Shallow splits occurring on the sidewall rubber | Incomplete knitting of surfaces caused by folding during moulding | Should remain in service unless casing cords are exposed |
| 13 | **NO VISIBLE DAMAGE** | The cover has been subjected to load whilst deflated, and because of this its condition is suspect | Factory (in addition to marking called for in A.P. 2337, Vol. 2, Leaflet B.2), the cover to be additionally labelled to indicate that it has been subjected to load when deflated |
| 14 | **RIM CHAFING** Abrasion of fabric in area above wheel flange | Under inflation or contamination of the bead area by oils, etc. | Factory |
| 15 | **TYRE LEVER DAMAGE** Localised fracture of bead clinch fabric | Incorrect use of levers | Factory |
| 16 | **BEAD TOE CHAFING** Narrow circumferential areas of abrasion on the tube base corresponding to the bead toe position | Sharp bead toes, excessive movement of the bead | Scrap |
| 17 | **THINNING AT BEAD TOE POSITION** Narrow circumferential areas on the tube base at the bead toe position where the rubber thickness has been reduced. It is usually easily detected by feel. (Not illustrated) | Excessive transfer of brake heat to tube | Scrap |




Tyres should be replaced when worn to base of grooves "A"




**WARNING**

UNIT REPAIRS TO ISOLATED CUTS IN THE TREAD ARE TO BE CONFINED TO TYRES WITH PRESSURES 100 P.S.I. OR LESS AND TYRES FITTED TO AIRCRAFT WITH LANDING SPEEDS OF 100 KNOTS OR LESS

Table 2. Classification of unserviceable aircraft tyres

F.S./3



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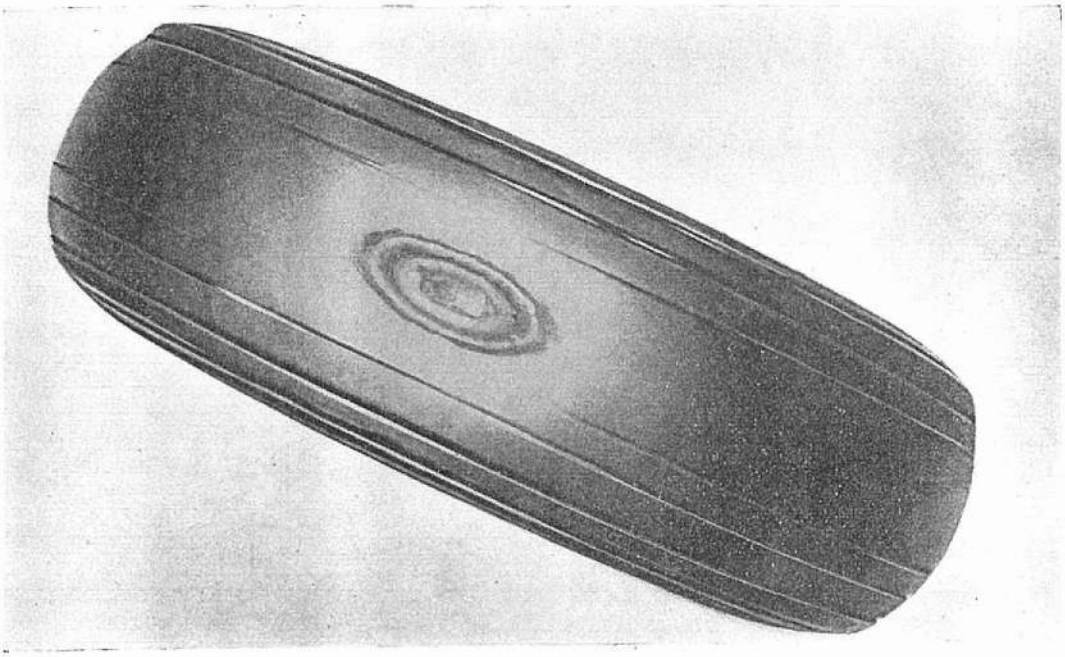


Fig. 1. A scuffed outer cover

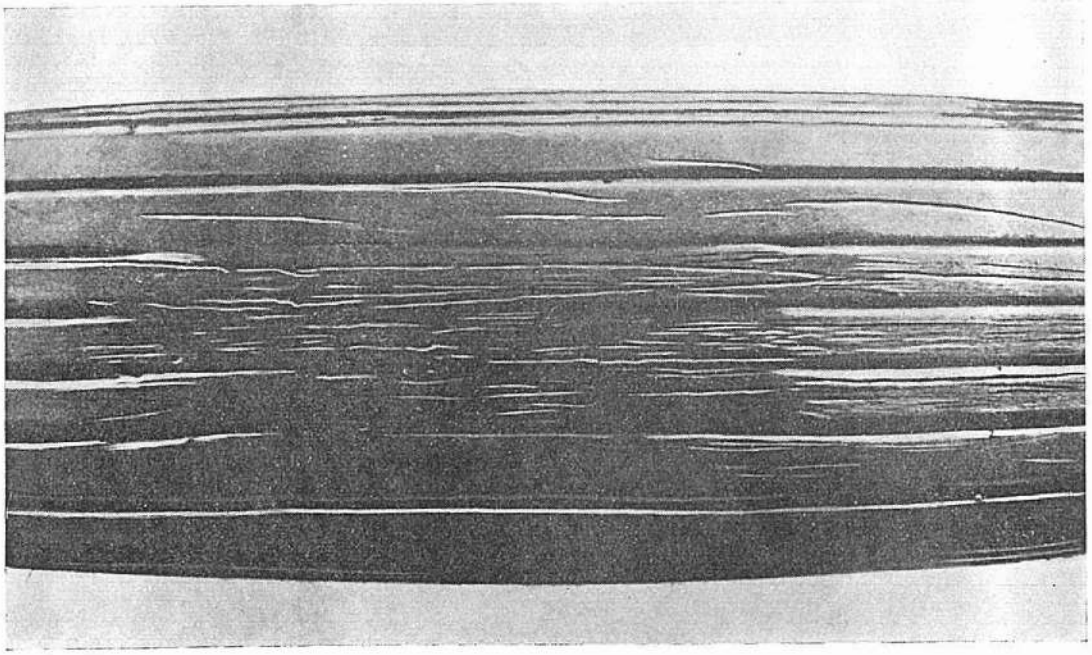


Fig. 2. A flatspot on a cover

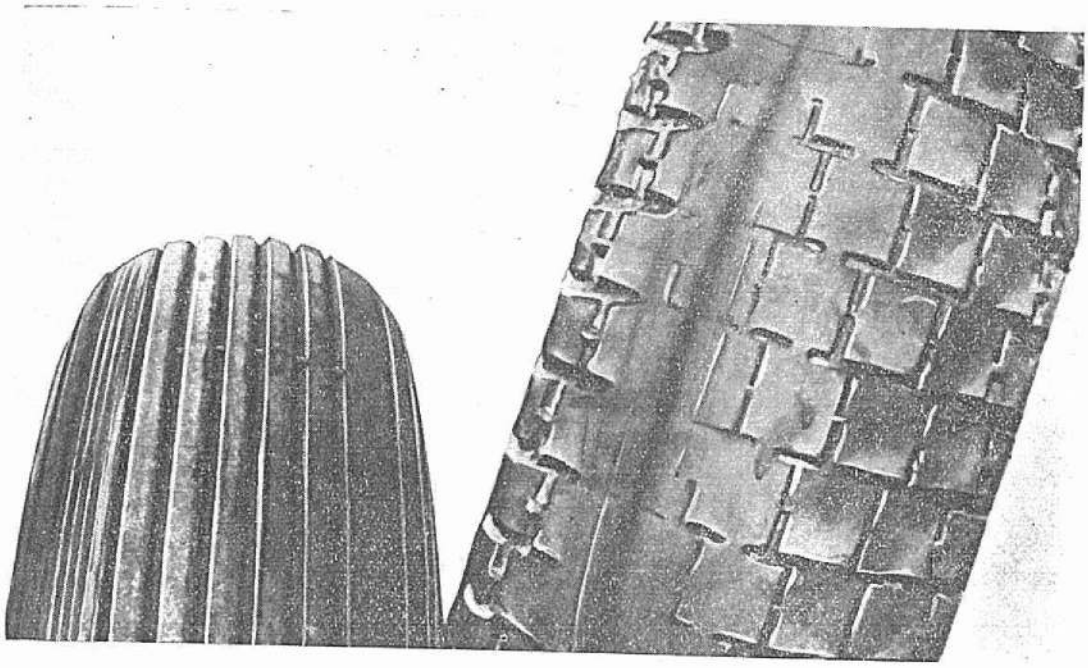


Fig. 3. Uneven tread wear

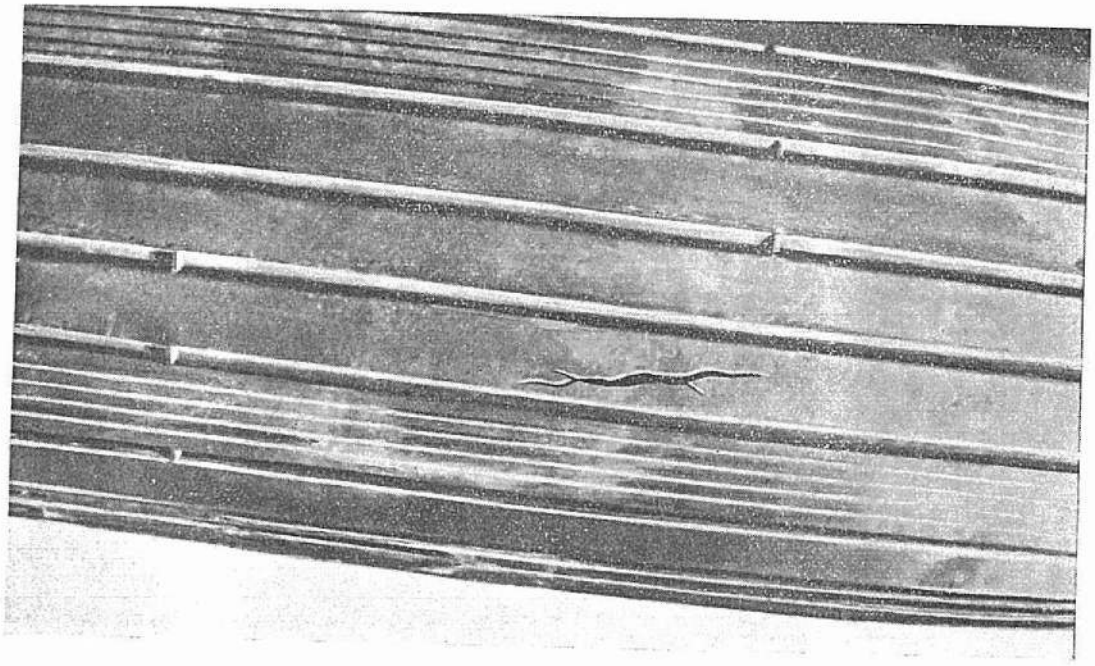


Fig. 4. Tread cut damage

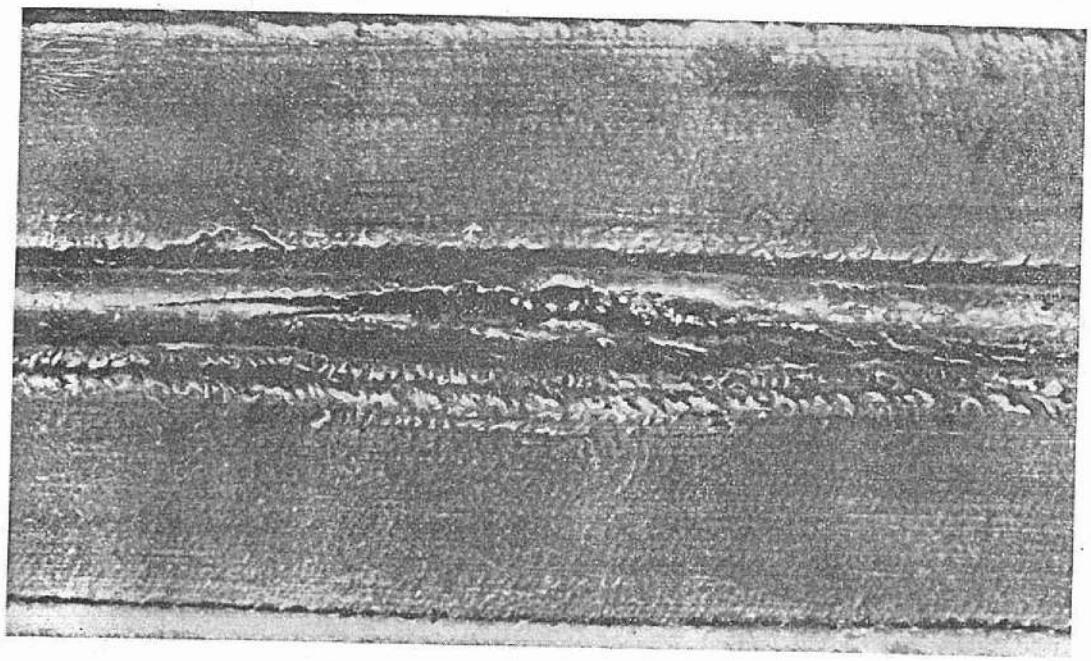


Fig. 5. Splitting in the base of a groove

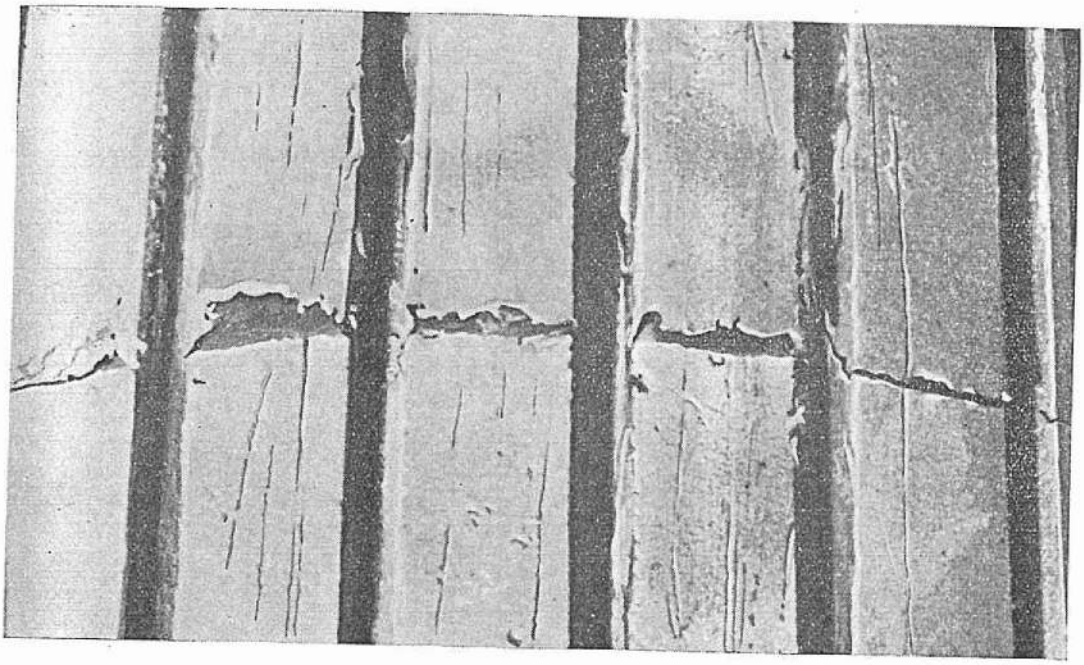


Fig. 6. An open tread join in a cover

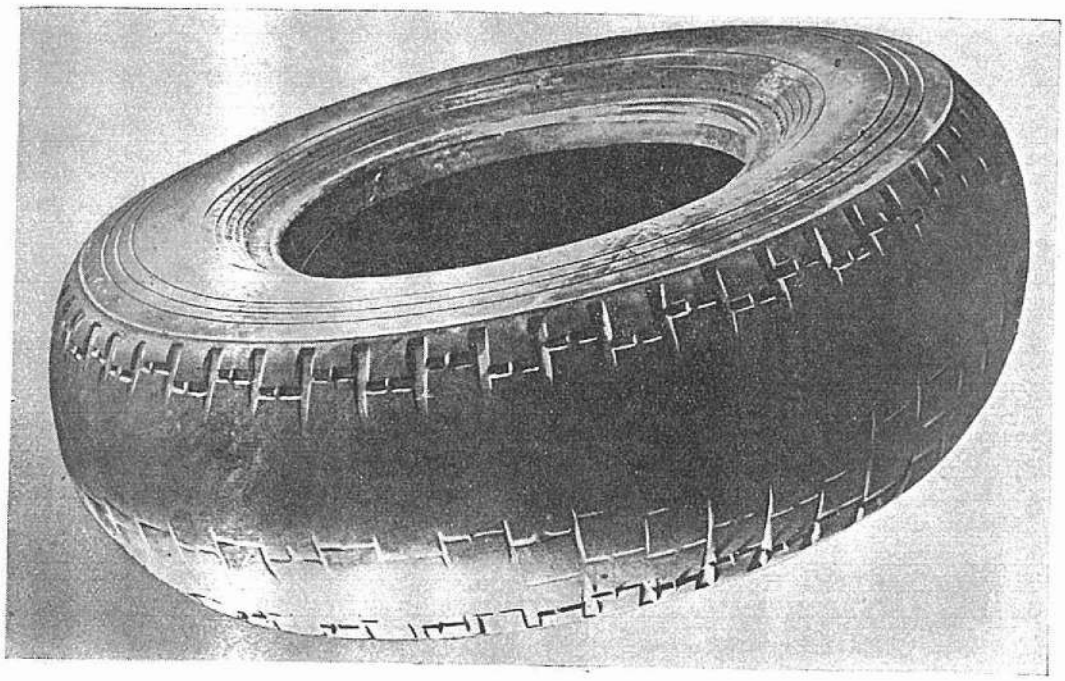


Fig. 7. A worn out cover

Fig. 8. Contamination of the rubber

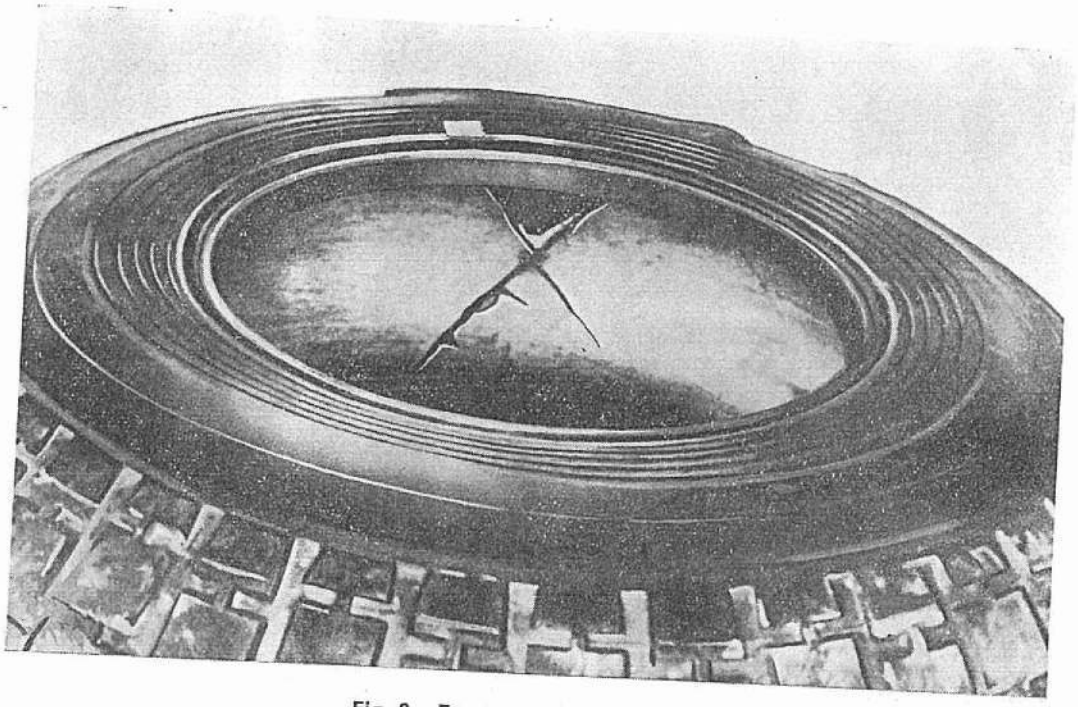


Fig. 9. Fracture of casing cords

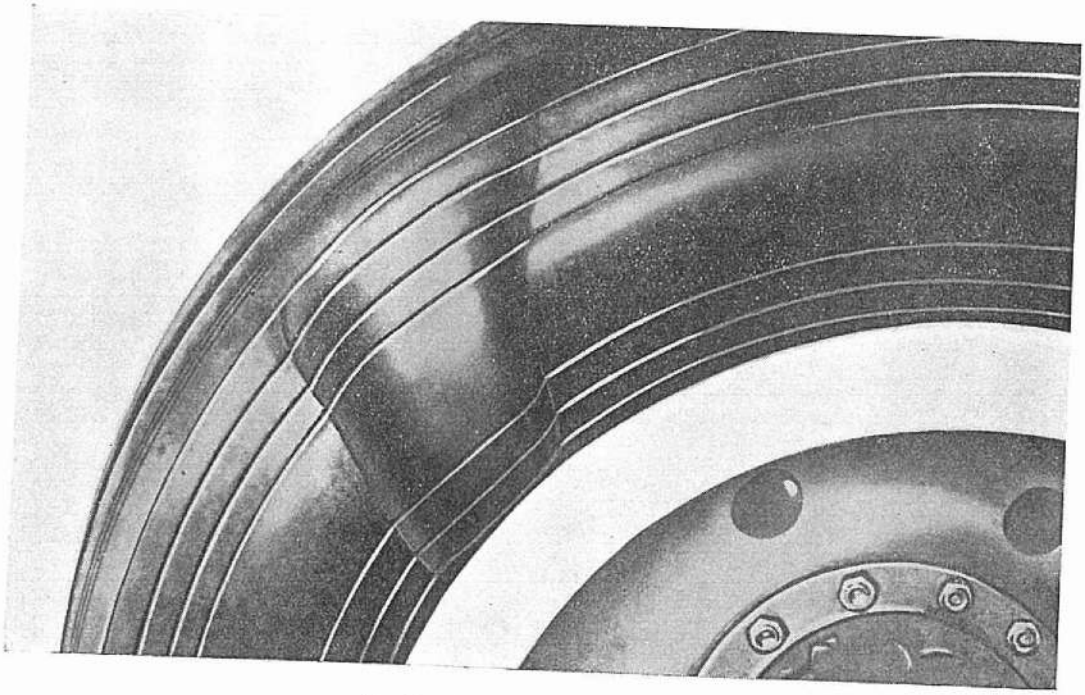


Fig. 10. Air trapped in cover

Fig. 11. Cracks in sidewall of cover

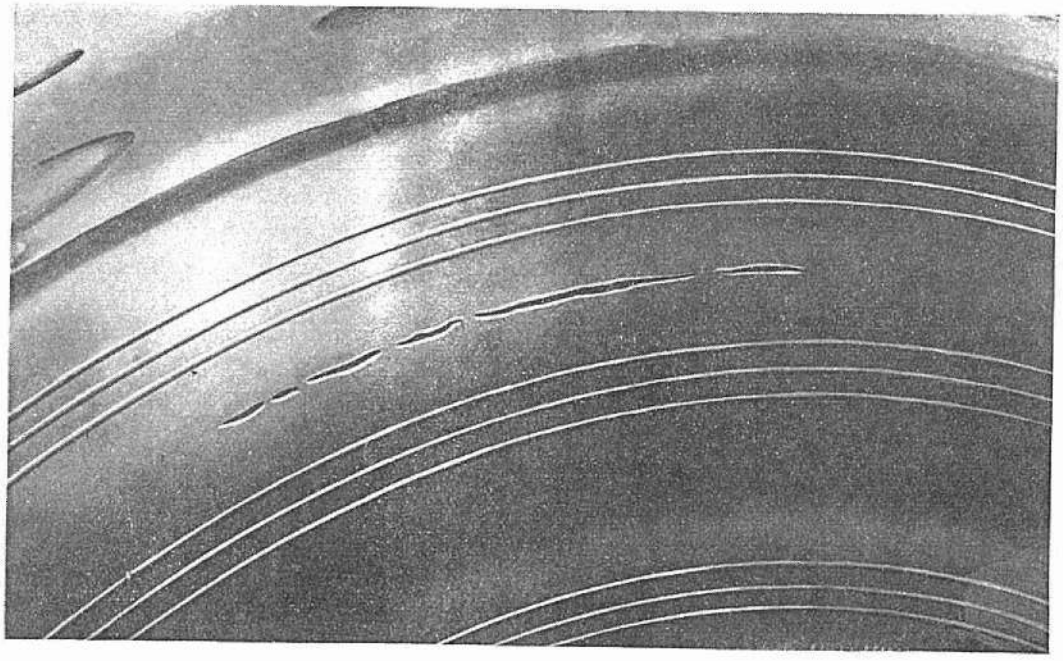


Fig. 12. Splits in sidewall of cover

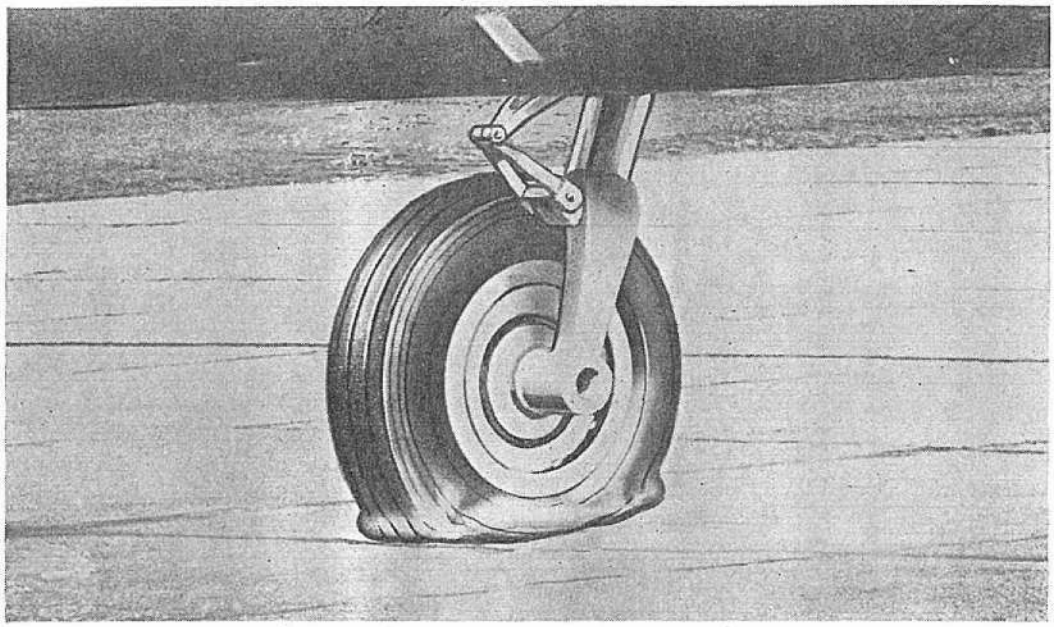


Fig. 13. Load on a deflated cover

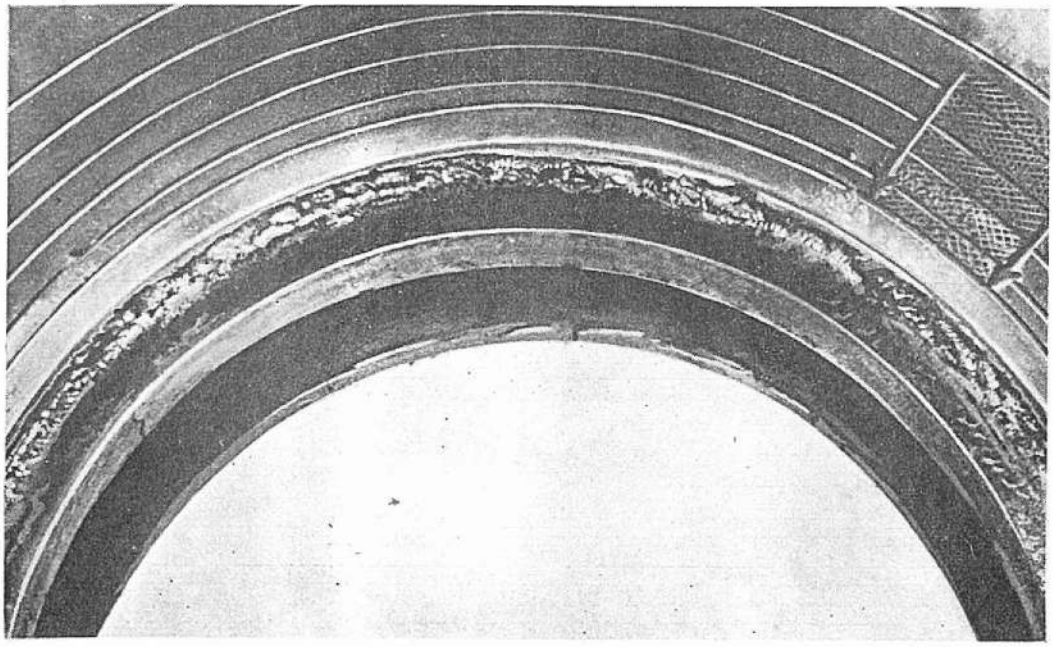


Fig. 14. Abrasion of rim fabric

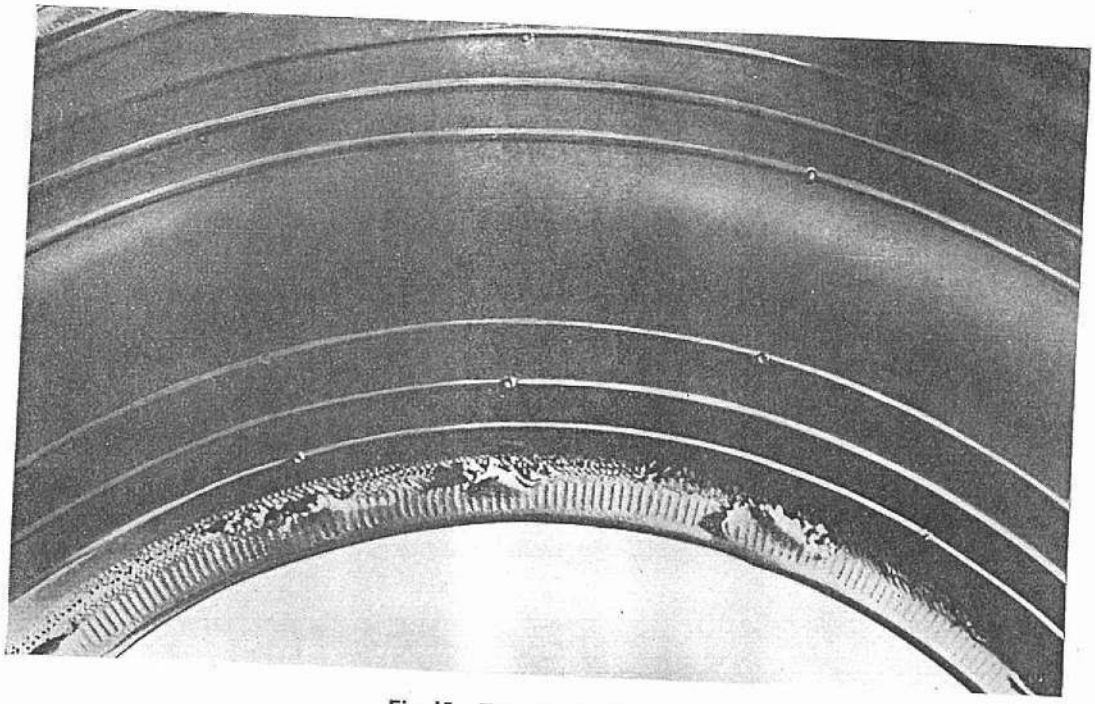


Fig. 15. Tyre lever damage

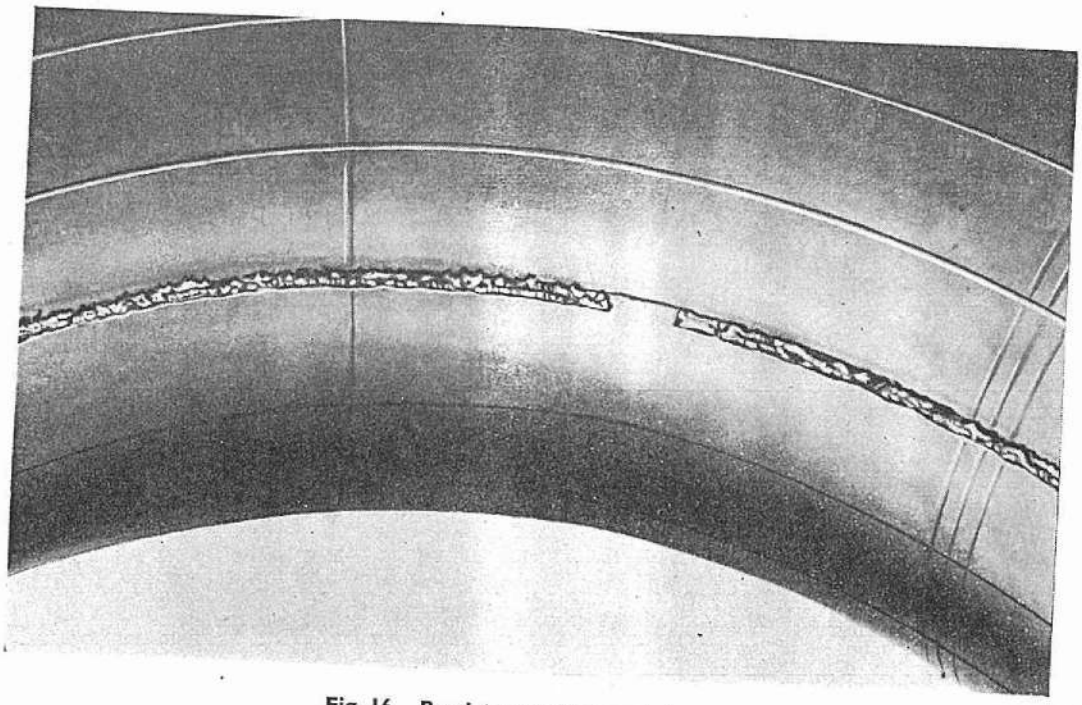
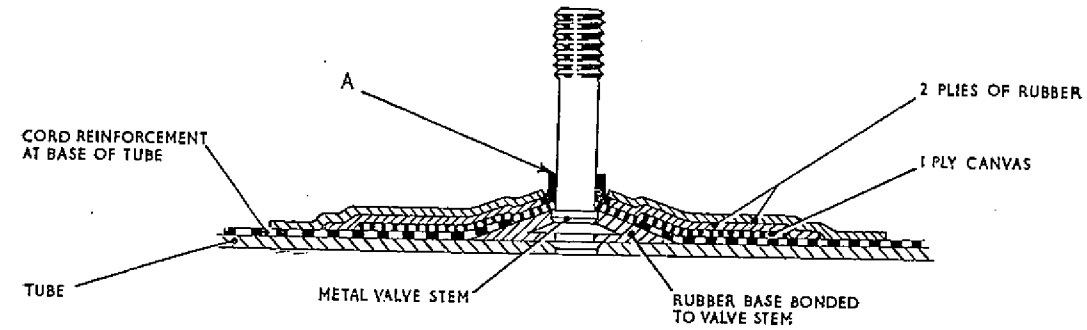


Fig. 16. Bead toe chafing on tube



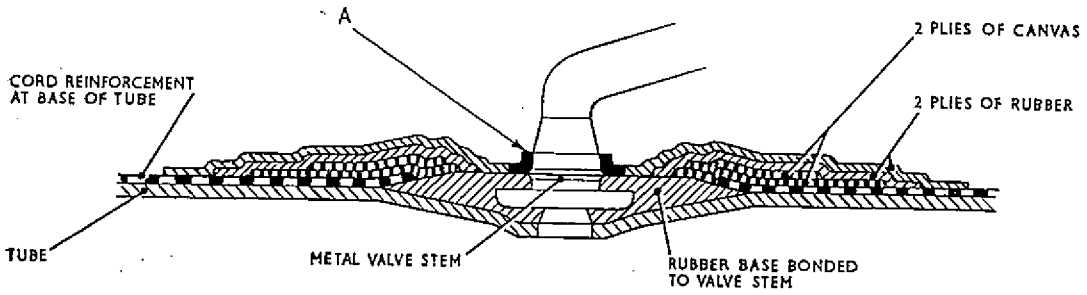




**Fig. 17. Tube reinforcement at valve position**