SECTION 4 BODY

1 A general dissertation on body alignment
2 Timbers for body building

GAZETTE NO.29 MARCH 1985

All the Healey chassis types which carry their fuel tanks slung under the rear platform (i.e. other than ‘D’ and 'E' types) have a design weakness in their chassis directly above the rear axle.

In the case of the ‘A','B','C' and 'BT' types, the vertical dimension of the box section at this point is relatively small, whilst the bottom plate has an arched shape, which means that it is inclined to 'jack knife' upward when subjected to heavy tail loads such as fourteen gallons of fuel plus a spare Riley block in the boot. This causes the sides of the box section to bulge and then crack adjacent to the apogee of the bottom plate. The sides of the box section are partly double skinned at this point spot welded together. If the two layers decide to bulge in opposite directions then the sound of the spot welds breaking may be heard at times of maximum stress.

In the case of the Salisbury axled cars ('F' and 'G' types) the plot is even worse, since the bottom plate is removed to allow the road spring to be sited directly over the axle, inside the chassis. The resultant ‘Top hat‘ shape is very weak, and is usually found to be deformed into an elliptical shape. The cure is to fabricate a bottom plate assembly strong enough to have a far greater resistance to longitudinal compression: see Figs. 29, 30 and 32.

It will be apparent that when all this has happened, the tail of the car will drop. With reference to Fig.31, one may regard each rear wheel arch/wing/quarter body assembly as a fairly rigid unit rotating in a clockwise direction about and axis through the top of the chassis (x). It will therefore be apparent that when this happens, the lower front edge of the wing assembly will push the bottom of the panel at 'c' forward so that the door gap is closed at this point. Healeys with paint rubbed off the door in this area are extremely common! ’

It will also be apparent that the roof or hood will be pulled back so that the windscreen pillars impinge noisily upon the quarter light frames at the point 'b'. Also cracks will have appeared at the highly stressed areas 'a' and 'd'.

To confuse the issue still further, similar symptoms may be apparent due to the failure of the rivets which fix the rear wheel arches to the angle iron frame which surrounds the floor of the boot (I prefer to use stainless steel nuts and screws at this location), or failure of the rear body mountings which support this frame, generally due to rust, or, of course, any permutation of these possibilities.

Once the chassis has been repaired, the position of the boot floor frame and wheel arches controls the attitude of the complete rear section of the boot and roof. The forward edge of the frame is bolted to the top rear cross member of the chassis so that its height and position is fixed. The attitude of the assembly is therefore controlled by the body mountings at the sides, which can be shimmed to the required height with a firm packing material.

At the front of the body the engine bulkhead controls the height of the scuttle etc. and may have dropped, especially on the exhaust side, due to the elongation of its fixing holes. I suggest that a couple of stiff dural plates be used to sandwich the bulkhead at this point, and the whole assembly redrilled.

The method used on C1902 was to assemble the bulkhead mounting bolts loosely locating the sandwich plates against the bulkhead. The bulkhead was then jacked up as high as it would go, and the sandwich plate/bulkhead drilled with six, 3/16” holes, and fitted with stainless steel screws and nuts to prevent the bulkhead returning to its lower position. (Fig.33).

Throughout these adjustments, each door must be considered for fit and clearance. For this reason I consider that during any major body rebuild, it makes sense to rebuild the doors first. Also, by the time the doors are finished (or not, as the case may be) the owner will have investigated his aptitude for body restoration before too much damage is done. Many Healey restorations have foundered at this point, the cars either never being seen again, or reappearing as sub-standard specials. The coach built body is generally constructed in the manner of a piece of furniture, with little regard for the stresses involved or the need for triangulation where possible to reduce distortion of the frame when this is subjected to years of vibration and movement.

In the Vintage years, chassis were generally designed to be torsionally flexible, and of necessity, the bodies had to flex with them. The Healey, however, has a relatively stiff chassis, and if the body frame is made as stiff as possible, it will still be flexible enough, thus reducing the tendency of the aluminium panels to crack, while the car will be quieter running.

It will be apparent that many things are not in our favour, for instance, the Tickford is a very curvaceous shape, but the body framework is constructed by joining together a vast collection of small pieces of wood cut from solid rather than bent from straight sections, so that at the ends of each piece where a joint must be made, we frequently find a short diagonal grain. In common with all the coachbuilt Healeys, the Tickford has a door pillar which terminates at window sill level, and therefore gains no support from the roof, and also suffers additional stress from the door which is not only heavy, but heaviest at the opposite end to the hinges.

Its tendency to lean outward when the door is in the open position is resisted only by two coach bolts, close together near its lower end, and the compressive strength of the edge of the outer floor board and the door sill board against the bottom of the post.

The tendency of the post to move forward at the top and/or backward at the bottom when the door is released from its catch is resisted only by two fragile pieces of wood attached to the wheel arch timber and the outer aluminium panel, and at the bottom by a few rusty screws through the sill board. For body integrity these parts must be in sound condition. In practice they are extremely vulnerable to water thrown up from the road, and are therefore generally rotten

In the case of C.1902, the door sill is now made of Japanese Oak, the door post is fabricated from 18 s.w.g. steel plate, and vulnerable wood is covered with soft aluminium sheet and coated with underseal. Stainless steel nuts and bolts are used where appropriate in place of wood screws.

I do not intend to go into much detail about the problem of replacing decayed timber, other than to make a few general comments, since so much will depend on the facilities and capability available.

The assembly of body frame in the first place involves the insertion of a great many screws from the outside. The door post and front and rear edge of the door is then fitted with with an overhanging steel strip. The aluminium panelling is then fitted over the frame, and folded around the steel strips, or wood frame, and in the latter case, nailed with hundreds of tin tacks. The proper way to attack the job is, therefore, to reverse this procedure, which will, of course, involve some damage to the aluminium, which you will have to repair by welding. The work required to repair the woodwork then becomes self evident, and no great problem, given that the original timber is still recognizable, and useful as a pattern.

The alternative method of 'fiddling' pieces of wood out and back in again can sometimes be done. Wheel arches or door sill boards may be done this way, but other parts are more difficult and probably end up with a compromise solution. I was able to get away with some fairly crafty manoeuvres during the C.1902 rebuild, but it was of course only ten years old, and therefore not as bad as some Healeys are now.

For large curved timbers, such as the front door pillars, it is both more economical, and more satisfactory to laminate timber which is thin enough to be bent by hand around a rigid former, layers being added, and glued on with a modern water proof adhesive one at a time, each being allowed to dry for at least 48 hours. (Fig.34)

Once all the preceding items have been considered, it will still be apparent that the door is subjected to considerable stress when the body is subjected to bending or twisting loads, yet both the hinges and door catch arrangements are secured by quite small wood screws. Figs.35 and 36 suggest some modifications based on those used on C1902, although my steel door pillars and inertia reel seat belt mounting are additional refinements.

With reference to Fig.36, the bracket (e) is bolted to the back of the door pillar by c/s headed screws through the rear half of the top hinge. The rear end of a steel tie is bolted to the wheelarch, the front to the bracket (e) with a reinforcing angle piece underneath. This relieves the surrounding woodwork of all stress.

Inside the door, there is already a plate (c) which passes behind the window running channel, and a lug can be welded to this as shown.
A hard alloy plate (a) is bolted to the board (g) which must be in good condition (mine is now made from1/2" marine ply, which gives greater strength around the screw holes at its ends). The ties (a—b) and (b—c) can be made of 1/2"x1/8" steel strip, two pieces being shaped as shown, and welded on, so that two nuts and bolts can be used to adjust the tension. By this means the bottom of the door can be pulled inward and upward so that it closes slightly before the top, thereby ensuring freedom from rattle, and compressing properly any draught excluder one may fit along the lower edge.

It will now be apparent that the weight of the door is balanced against the weight of the rear wheel arch assembly by metal components under tension, whilst the stress in most of the woodwork is mostly compressive.

The remaining weak spot is the catch assembly on the front door pillar. This is not only under considerable stress from body flexure, but also from the impact of the door being slammed shut, whilst the timber at this point may be waterlogged due to cracks in the aluminium screen pillar panelling. (for this reason C.l902 now has a 20 s.w.g. steel panel in this location). Fig.34 shows a substitute for the original corner so that the timber is effectively sandwiched by the assembly. Stainless steel screws are, of course, used.

Finally, I would like to suggest that the boot lid aperture be modified to eliminate the problem of water leaking into the boot and into the adjacent timber, and to stiffen the aperture, thus reducing the tendency of the paintwork, and perhaps even the aluminium to crack at the corners.

Fig.37 shows how C.l902 is modified. The timber which supports the rubber seal is cut back flush to remove the existing rabbet. A steel channel is then fabricated to surround the entire aperture. A drain pipe of about 1" diameter at each bottom corner carries the water through the bottom of the boot by means of plastic piping. A triangular sealed section rubber is then glued to the under- side of the edge of the boot lid to ensure that the water falls into the channel without touching the boot lid timber. This modification also solves the problem of the boot lid sticking shut during freezing conditions, as the rubber is no longer in contact with the body.

In the case of C.l902, the channel was made from some redundant office partitioning. Starting with a 2"x2" x 16 s.w.g. angle, the necessary curvature was formed by heating and stretching one edge of the plate at intervals of about 11/2". The four sides were then formed into the desired shape at the corners and welded together. The assembly was then sprayed body colour, and fitted into position with a sealing compound and secured with 2" stainless steel screws. Most of the modifications in this article were carried out on Cl902 in the 1960's restoration, and have been proven by time and
100,000-+ miles since.

The car may be said by some to be more than somewhat non-original, and I am pleased to say I totally agree!

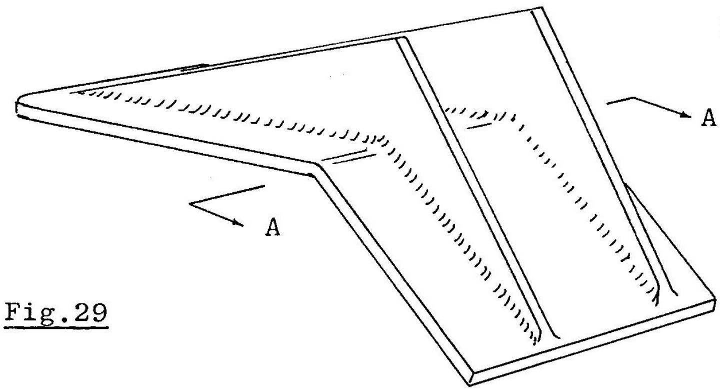


Fig.29

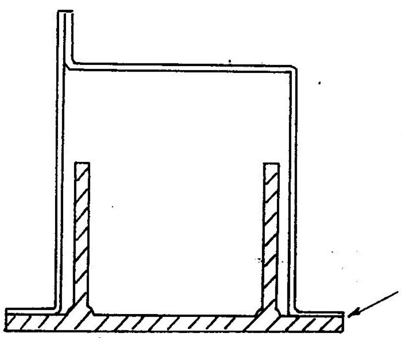
ALTERNATIVE CHASSIS MODIFICATION.

The above fabrication might be easier to fit, since it will only be necessary to remove the original base plate, leaving the flanges of the side in their original shape.

The vertical stiffening flanges should be positioned so that they, and the associated weld fillets fit inside the box section. (See Fig.30).

Note that the rear of the chassis should be jacked to stretch the side plates while the new assemblies are welded in place, although it will tend to drop a little as the welding cools off. Final adjustments will then need to be made to the attitude of the rear of the body by means of shims at the rear body mounting points.

Fig.30



Cross section at A-A showing position relative to existing chassis member.

Fig.31

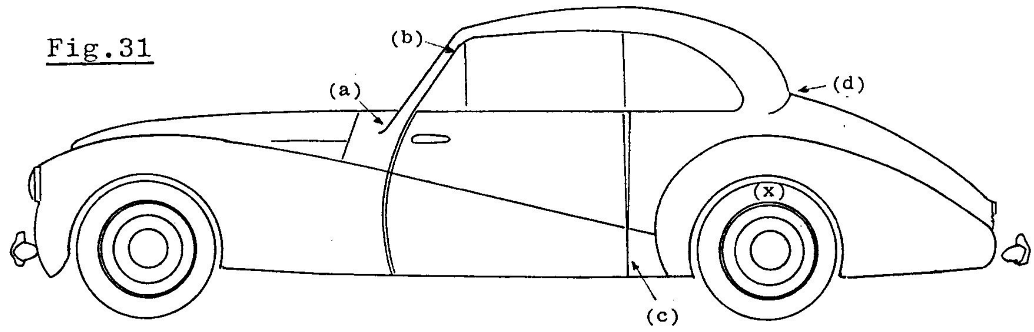


Fig.32

CHASSIS MODIFICATION AS ON C.1902

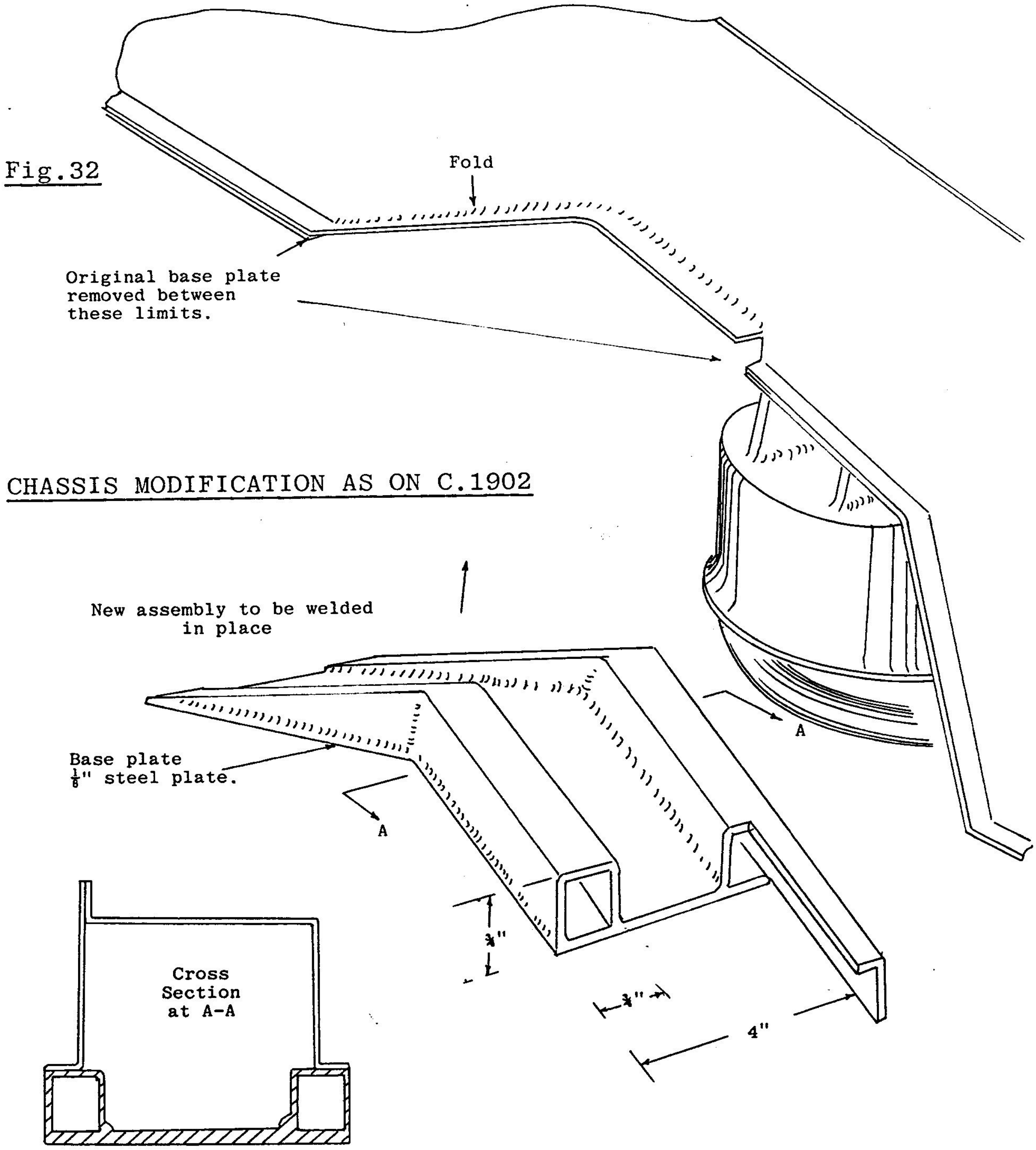


Fig.33

REINFORCEMENT OF FRONT BULKHEAD MOUNTING.

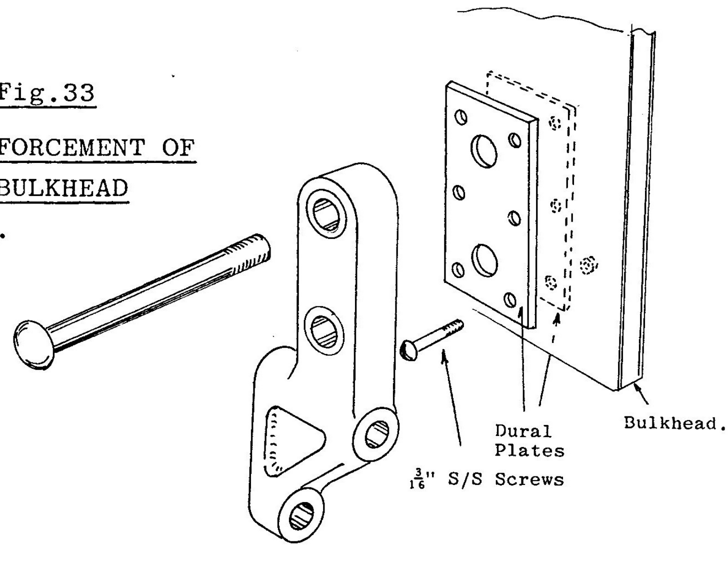


Fig.34

MODIFIED DOOR CATCH PLATE FIXING.

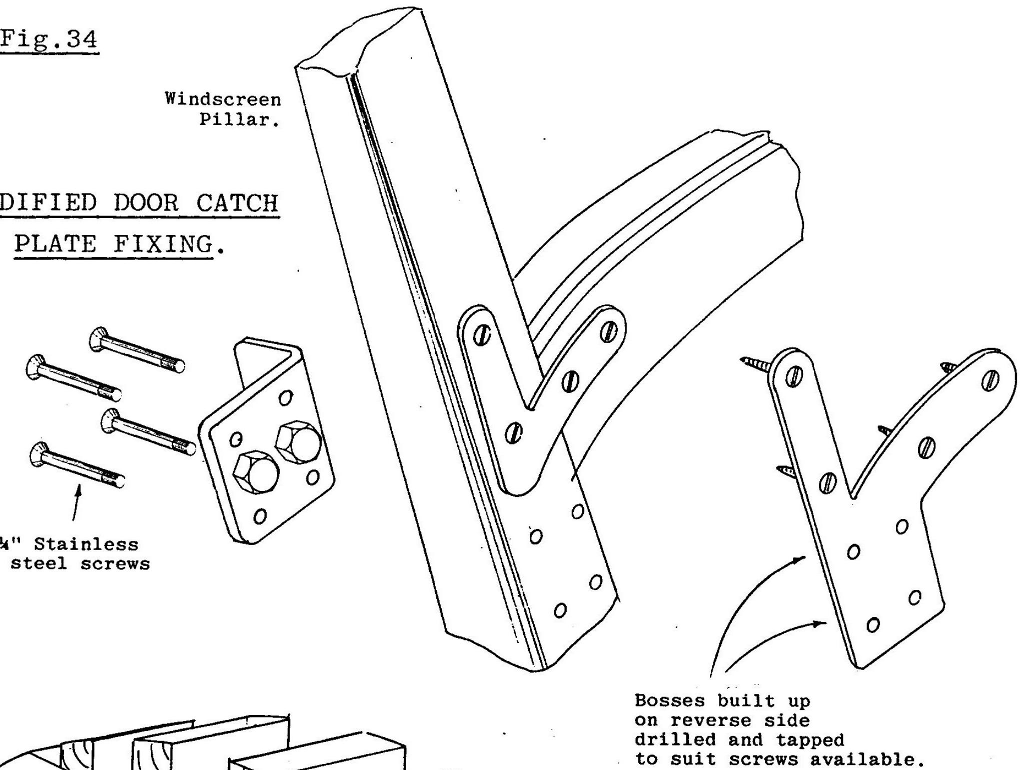


Fig.35

SUGGESTED JIG FOR FORMING LAMINATED FRONT DOOR PILLAR.

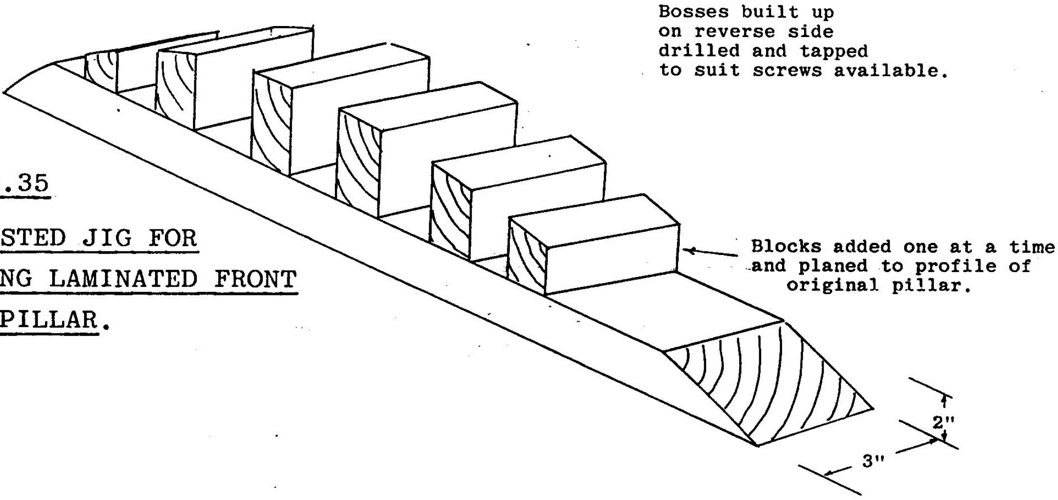
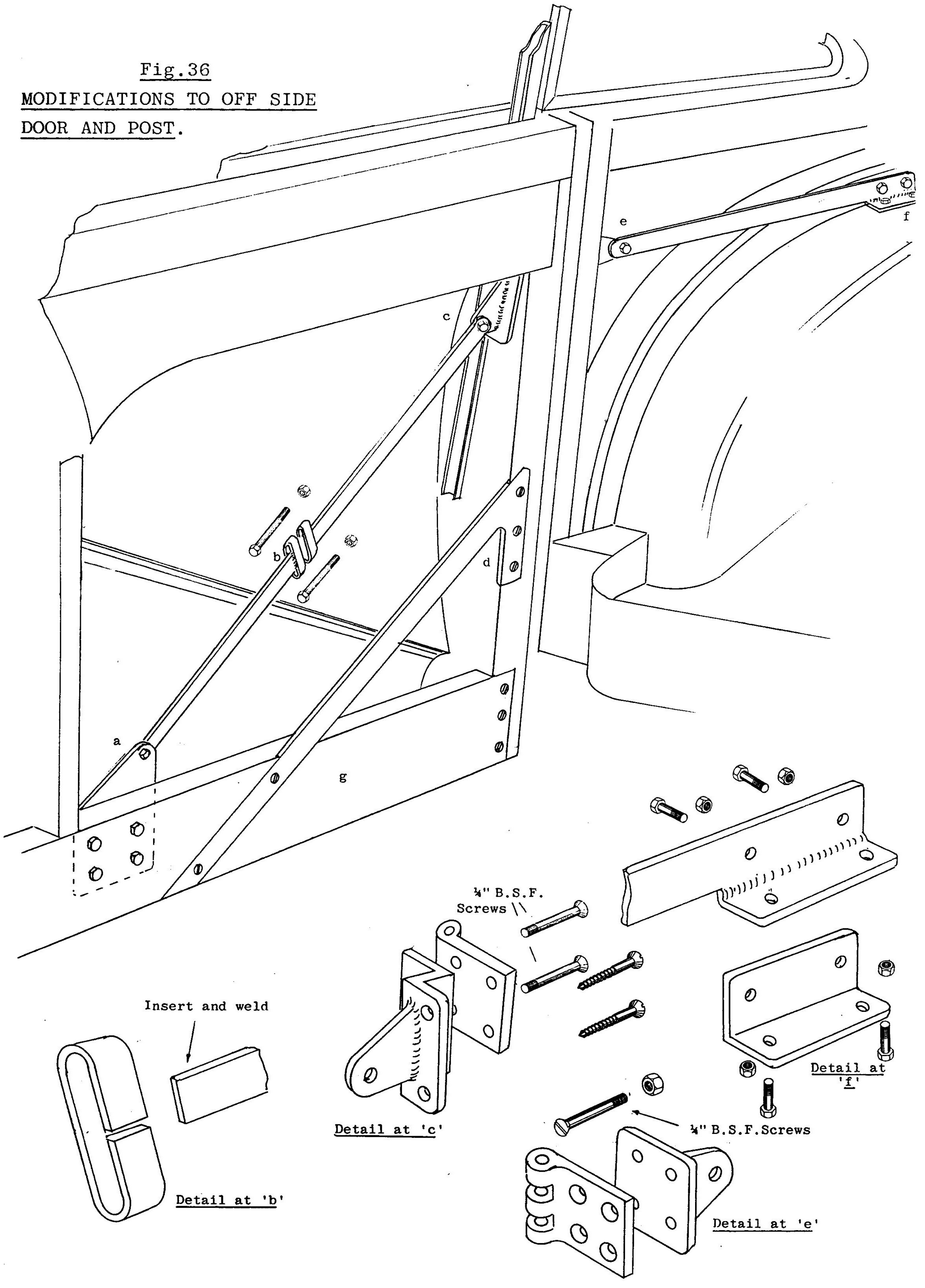


Fig.36

MODIFICATIONS TO OFF SIDE DOOR AND POST.



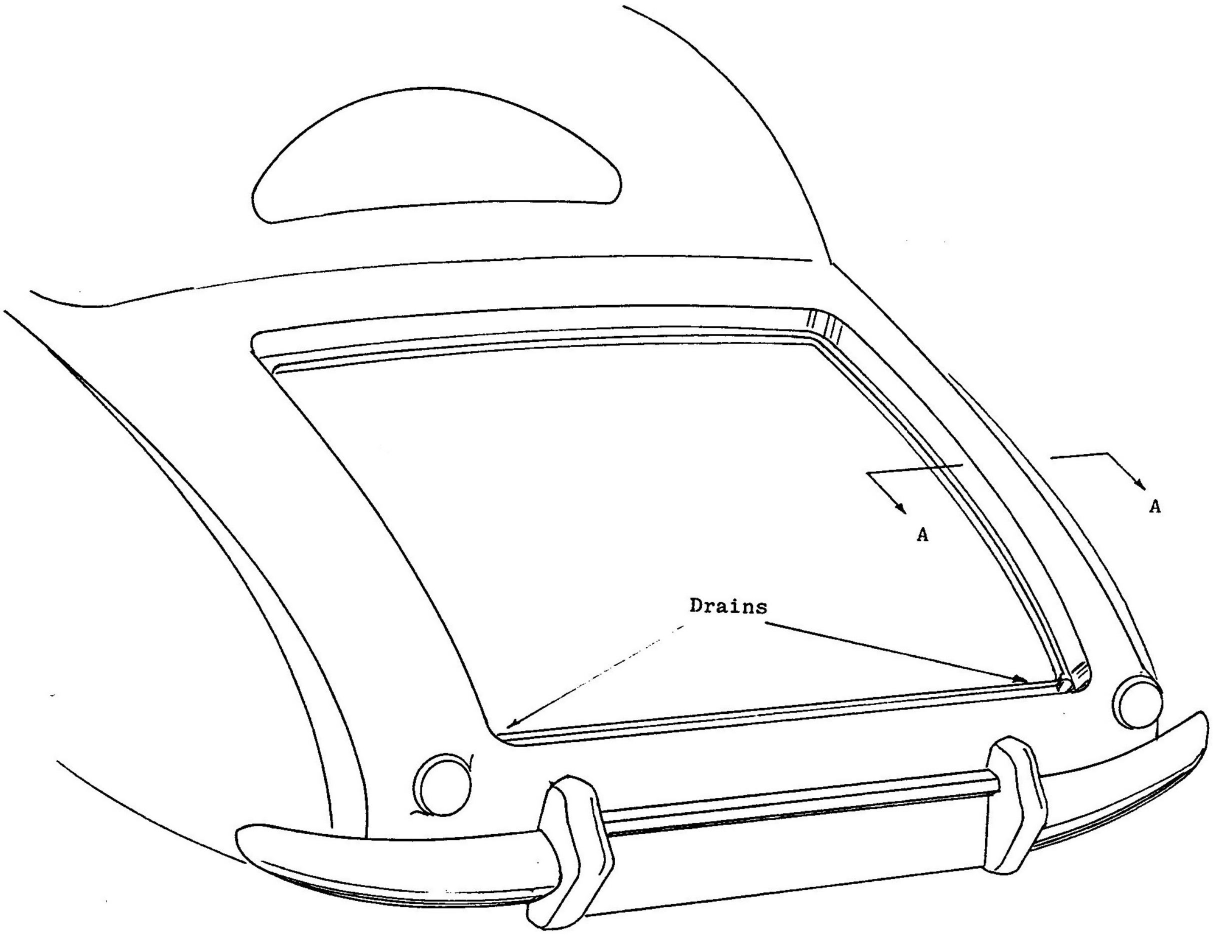
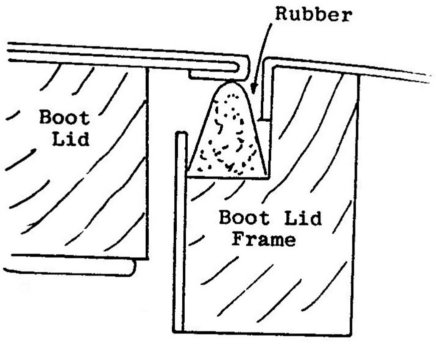
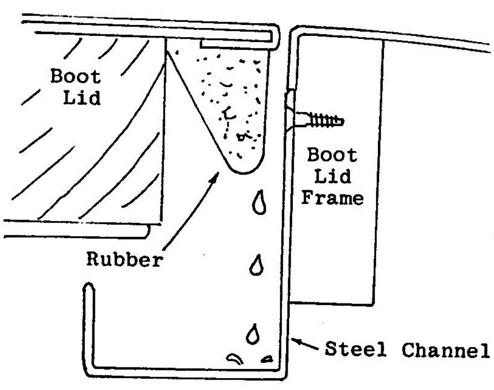


Fig.37. MODIFICATION TO BOOT LID SEAL ARRANGEMENTS.



CROSS SECTION AT A-A (ORIGINAL).



CROSS SECTION AT A-A (MODIFIED).

<u>TIMBERS FOR MOTOR BODY BUILDING</u>

BY R.E. MILLER.
(GAZETTE NO.15)

The idea of writing this article came to me upon discovering that most of the timber in my Westland is oak, as is some of the timber in Julian Parson's Westland, although he says he thinks there is some sweet chestnut as well, *(In the Classic & Sportscar interview with Geoffrey Healey, he said that whilst there were great shortages of materials, they did find a good supply of coffin bottoms!! - R.K.S).* We all, without question, accept the fact that ash is the best timber to use in a car body. Coachbuilders used this timber almost exclusively except when after the war, timber was scarce, and one had to make the best of what one could get.

The reasons for using ash can be summed up as follows:- it is a very stable timber having a very low moisture content when felled. It is also straight grained and free from knots. It can be nailed or screwed near the end without splitting, it is reasonably easy to work and it has an elasticity which enables it to bend and take shocks without breaking (very important to early coachbuilders who built on flexible chassis, but not so important on a fairly rigid chassis like the Healey).

There is, however, one very bad thing about ash which is that it will not last very long in the wet. Boatbuilders will not use ash near or below the waterline. Thus wheel arches, bottom rails of doors etc. rot first. (Postwar Riley owners will have experienced this at first hand as there are at least four places where the timber is exposed to the wet, notably the front door pillars).

However, properly looked after, there is probably nothing better than ash for body framing, although it is now a very expensive timber, and not always easy to get; so some ideas on substitute timbers may be welcome to some Healey owners. At this point I think a note on the subject of moisture content of timber is due. Moisture content (M.C.) is expressed as a percentage of the timbers dry weight, so a piece of timber with a M.C. of 100% contains equal amounts of wood and water. Seasoning is the act of reducing the M.C. without damaging the timber, which is easier said than done.

To this end, timber is felled in the Autumn and Winter before the sap starts to rise. Air drying will reduce the M.C. to between 17% and 23%, the low figure being about right for motor bodies. Larger section of timber will case harden (the outside will dry leaving the inside still wet). When a piece of this timber is cut lengthwise it will warp due to stresses set up when the wet portion begins to dry. This brings us back to ash, which has one of the lowest M.C.s when felled (as opposed to elm which can have a M.C. of over l00%:- a two ton elm log containing over 1 ton of water). This low M.C. in ash means that the chances of ‘case hardening‘ are less, thus making it a very stable timber.

The timbers described below are those which are generally available at the average timber yard. Timber is classified as either hardwood or softwood. These are botanical terms, not indications of strength or hardness. For example, Balsa, one of the softest woods known, is a hardwood!

<u>HARDWOODS</u>

<u>OAK</u> Two varieties are generally available:

(a) English Oak. This is extremely strong and durable but it is heavy and may move after cutting. It reacts with ferrous metals, damaging both timber and metal. It is quite difficult to work.

(b) Japanese Oak. This is more stable than English Oak, but not so strong, being inclined to be brittle. It also reacts to ferrous metals, but not so badly. It is easier to work than English Oak.

SWEET CHESTNUT

An excellent substitute for ash, being tough, straight grained, free from knots and fairly stable. It will also withstand the action of water (hence its use for hop poles, fence stakes etc.) It is not usually available, but a timber yard specialising in homegrown timber may have it.

MAHOGANY

A very stable timber, but inclined to be brittle, and also expensive. Not recommended. Very strong but also very difficult to work. The sap forms a substance similar to sand which blunts the tools very quickly. Not recommended.

IMPORTED HARDWOODS SUCH AS UTILE, IROKO AND KERUING.

These are teak substitutes. They are tough, greasy and difficult to work, but are very water resistant. They are also heavy timbers.

SAPELE, AGBA, RAMIN.

Fairly strong but not so tough or water resistant as the above, fairly difficult to work.

BEECH.

Fairly strong, easy to work but goes brittle with old age and damp. Not recommended.

ELM.

This timber will put up with any amount of water, but will twist and warp when drying. So unless you intend to go submarine motoring, it is not recommended.

SOFTWOODS.

PINE.

There are a great variety of pines from pitch pine (very heavy and greasy and difficult to work) to yellow pine (light, straight grained, even textured, one of the nicest timbers to work with, but extensively used by the Victorians who depleted the forests, and it is now scarce and expensive, and only used for the highest quality work, including pattern making).

DEAL.

This is a commercial term which covers a variety of softwoods of pine and fir origin. Used sensibly, this is quite a good timber. The darker varieties are usually stronger than the lighter ones except in the case of spruce, which is a strong fibrous timber which would make a good cheap substitute for ash if it was not so difficult to work, and had less knots.

DOUGLAS FIR.

Also called British Columbian Pine (B C Pine) Oregon Pine. A very strong timber, good resistance to water, straight grained, fairly stable but inclined to split when nailed or screwed near the end.

PARANA PINE.

This is the buff coloured timber which has red streaks in the heartwood which is very popular for indoor use - shelves, bookcases etc. Not very stable and not recommended, as it is not resistant to water. It is also inclined to be brittle.

CEDAR.

Properly Western Red Cedar not a true cedar. This is the "Garden shed" timber. Unfortunately, this timber has no strength and will not withstand shocks but its water resistance is excellent. Trees have been found which have been lying on the round for 1000 years, the timber of which is still good.

SUMMARY

If you cannot get ash or are worried about the dreaded rot setting in again, then use, with discretion, the following timbers:-

ENGLISH OAK.

For strength and water resistance but do use brass or at least galvanised screws, nails and fittings.

SWEET CHESTNUT.

Use this for any part of the framework.

UTILE, IROKO ETC.

Generally too heavy and difficult to work so not really recommended.

SAPELE, AGBA, RAMIN.

Use on straight sections although some varieties are inclined to split.

SOFTWOODS. "from the shelf" (DEAL)

Use with discretion for non-stressed members or if cash is limited use Sikta Spruce everywhere. This is one of the toughest common softwoods (Once used to a great extent in aircraft manufacture)

DOUGLAS FIR.

Use on straight sections but watch the splitting problem.

FINALLY:

Some hints on improving the strength if substitutes are used:

(a) Keep the grain as long as possible on curved sections. The section which takes the . rear end of the front wing of my Westland comes to mind;- See Fig.38.

(b) Use brackets and bolts to increase the strength of joints (See Fig.39) Let the brackets and bolt heads in flush where necessary.

R.E.Miller.

Fig.38.

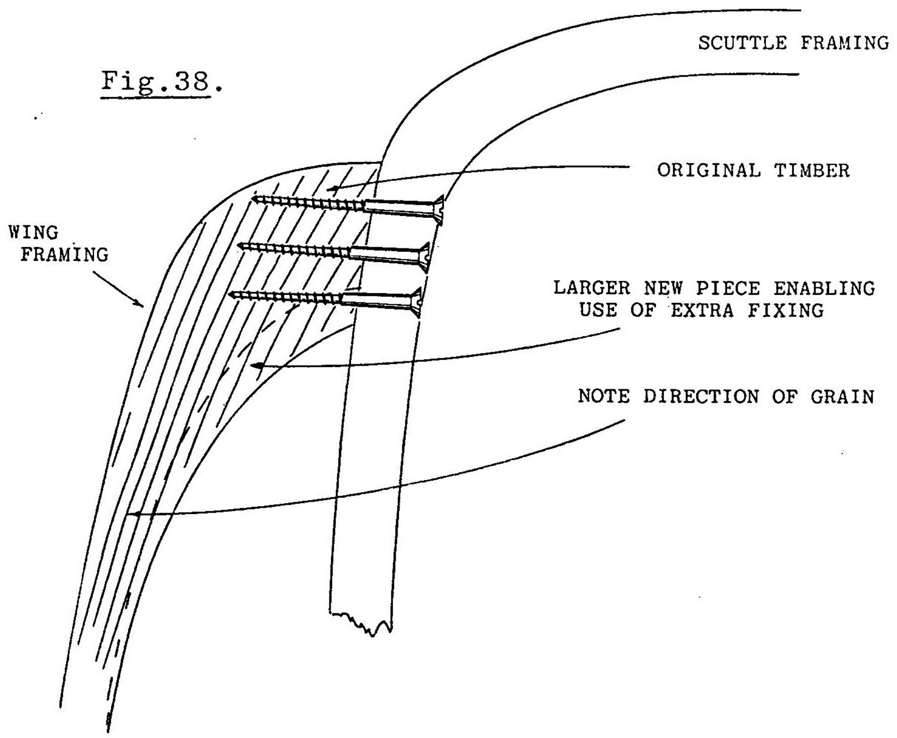
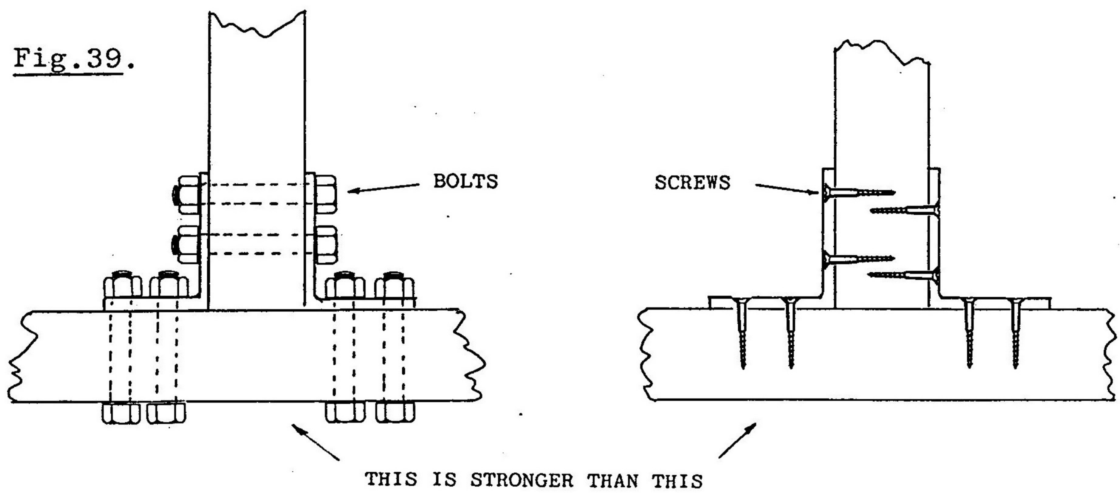

SCUTTLE FRAMING
ORIGINAL TIMBER
WING FRAMING
LARGER NEW PIECE ENABLING USE OF EXTRA FIXING
NOTE DIRECTION OF GRAIN

Fig.39.


BOLTS
SCREWS
THIS IS STRONGER THAN THIS