



FIGURE 6-39

Residual Stresses from Prestressing and Shot Peening a Leaf Spring (From Fig. 6.2, p. 61, in Almen and Black, *Residual Stresses and Fatigue in Metals*, McGraw-Hill, New York, 1963, with permission)

the same direction as its service loading, prior to its being placed in service. The yielding that occurs during prestressing creates beneficial residual stresses.

Figure 6-39 shows an example of prestressing applied to a truck spring. The spring is initially formed with more contour than that needed at assembly. It is then placed in a fixture that loads it exactly as it will be loaded in service but at a level above its (tensile) yield strength to preset it. When the load is released, it springs back to a new shape, which is that desired for assembly. But, the elastic recovery has now placed the material that yielded into a residual-stress state, which will be in the opposite (compressive) direction from that of the applied load. Therefore this residual stress will act to protect the part against its tensile service loads. The residual stress patterns are shown in the figure and also indicate the result of shot peening the upper surface after prestressing. The two treatments are additive on the upper surface in this case, affording greater protection against fluctuating tensile stresses in service. Note that if the part were reverse-loaded in service to the point of yielding the upper surface in compression, it would relieve the beneficial compressive stress and compromise the part's life. Thus, this approach is most useful for parts whose service stresses are unidirectional.

SUMMARY Residual compressive stresses can be the “fatigue designer’s best friend.” Properly configured, beneficial residual stresses can make an otherwise unworkable design safe. The designer should become thoroughly familiar with the means available for their creation. This brief description is intended to serve only as an introduction to a complicated topic and the reader is urged to consult the literature on residual stresses, some of which is noted in the bibliography of this chapter.