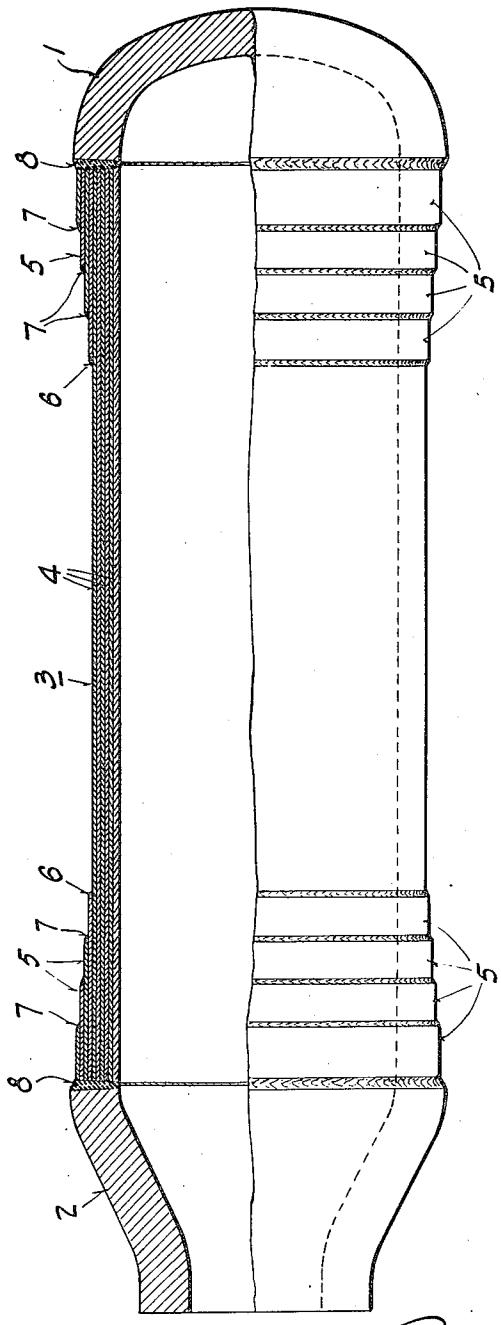
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MULTILAYER PRESSURE VESSEL

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MULTILAYER PRESSURE VESSEL

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2 Claims. (Cl. 220—3)

This invention relates to a multi-layer pressure vessel.

A multi-layer shell construction has been found to be of great utility in pressure vessels for high pressures. High strength steel is readily obtainable in the form of thin sheets which can be rolled into cylinders for the construction of the pressure vessel shell. While the heads or end sections of the vessel can also be laminated, this form of construction for them introduces so many complications that it is preferred to use solid end sections made by forging or pressing. Since these are necessarily of massive construction for large vessels designed for high internal pressure, it is difficult or impracticable to obtain end sections with as high a strength as the relatively thin sheets used to make the pressure vessel shell. The end sections must, therefore, be made correspondingly thicker than the shell sections and it is necessary to devise means for satisfactorily uniting the thick end sections to the thinner shell made of higher strength steel.

The primary object of this invention is to provide a pressure vessel construction in which thick end sections are united to a thinner shell section fabricated from a plurality of sheets of metal with a higher tensile strength than is readily obtainable in the end sections.

This and other objects of the invention will be clear from the following detailed description and the accompanying drawing in which:

The sole figure is a side elevation partly in longitudinal section of a pressure vessel built in accordance with this invention.

Referring to the drawing, the pressure vessel comprises end sections 1 and 2, and a multi-layer shell section 3 fabricated from a plurality of sheets 4 of which the innermost sheet may be somewhat thicker than the others as shown in the drawing. Unlike the shell section, which is of multi-layer construction, the end sections 1 and 2 are solid and are formed by suitable forging, pressing, machining, or other operations. Of the two end sections illustrated in the drawing, 1 is a closed head, and 2 an open cone adapted to be closed by any suitable type of closure. The term "end section" is used hereafter to refer to either since the particular construction used for the end sections of the pressure vessel forms no part of this invention.

In pressure vessels of large size designated for high internal pressure, the end sections may be of very considerable thickness, up to ten or twelve inches, or possibly even more. They must be forged or pressed or otherwise formed from metal which can stand the forming operations. Carbon steel which will meet the following specification has been found to be suitable.

	Per cent maximum
Carbon	0.28
Manganese	1.25
Phosphorus	0.050
Sulphur	0.050

End sections can be obtained from this steel which will, after being normalized and drawn, have a minimum tensile strength of 67,500 pounds per square inch and a yield point of from 36,000 to 41,000 pounds per square inch.

Higher strength material can be readily obtained in thin sheets suitable for forming the multi-layer shell section. A minimum tensile strength of 95,000 pounds per square inch and a minimum yield point of 70,000 pounds per square inch can be obtained with steel which will meet the following specification:

Carbon	per cent maximum	0.25
Manganese	per cent	1.15 to 1.25
Molybdenum	do	0.40 to 0.70
Silicon	per cent maximum	0.25
Phosphorus	do	0.035
Sulphur	do	0.040

The shell is built up of layers 4 according to methods set forth in the patent to Richard Stresau, No. 1,925,118, and because of the high strength of the material used in it, the multi-layer shell section 3 can be materially thinner than the end sections 1 and 2.

Reinforcing bands 5, of progressively decreasing length, and preferably of the same material used for the layers 4, are applied adjacent to the ends of the shell section in sufficient number to build up its thickness at the ends nearly equal to that of the end sections 1 and 2. The abutting ends of the reinforcing bands are welded together so that each forms a complete ring about the shell. It is also preferred to weld the longest bands to the outermost layer of shell section 3 by circumferential fillet welds 6, and each succeeding band to the one below it by similar welds 7.

When the shell section has been prepared as above described, its ends and those of the end sections are machined to form welding grooves and the parts are welded together by circumferential welds 8. Alternatively, the end sections may be welded to the shell section before the reinforcing bands are applied. In this event the

reinforcing bands are then wrapped about the ends of the shell section, their abutting ends are welded together, and the circumferential weld 8 is completed to unite the reinforcing bands to the end section. Circumferential fillet welds 6 and 7 uniting each reinforcing band to the band inside it and the innermost band to the outer layer of the shell are also made when these welds form a part of the construction which is preferred.

Irrespective of whether these circumferential welds between bands are included or not, or whether the bands are applied to the shell section before or after it is welded to the end sections, a structure is produced in which there is no abrupt change in thickness from a thick end section to a thin shell, and no concentration of stress at the junction of these parts. A strong structure is thus obtained and one of much less weight than if the shell were constructed of metal having only the tensile strength of the end sections. By proceeding in accordance with this invention, it is possible to take full advantage of the relative ease of obtaining higher tensile strength sheets than end sections.

I claim:

1. A pressure vessel comprising a shell composed of a plurality of layers, a solid end section of greater thickness than the shell, a plurality of concentric reinforcing bands of less length than the shell surrounding the portion of the shell adjacent an end with each band of lesser length than the next inner band, a circumferential weld joining the innermost band to the outermost layer of the shell, a circumferential weld joining each of the succeeding bands to the band next beneath it, and a weld joining the layers of the shell and the reinforcing bands to the end section.

2. A pressure vessel comprising a cylindrical shell composed of a plurality of superimposed concentric closely engaging layers of high strength steel, a solid end section of lower strength steel and of greater thickness than the shell with an outside diameter substantially greater than the outside of said shell, concentric re-inforcing bands of less length than the shell around the portion of the shell adjacent said end, and a butt weld joining the layers of the shell and the reinforcing bands to the end section.

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