DISCUSSION

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The authors and the Standard Oil Company (Indiana) deserve the appreciation of the many engineers and industries concerned with gaseous detonation, and its avoidance for the safe operation of pressure and process equipment. The tentative indication that ductility of carbon steel apparently has little influence on bursting strength, and that maximum strain rate is less than in a Charpy "V" notch test, is of particular interest. Also, that analysis indicates that the strain rate for larger diameter vessels decreases; the pressure pulse would also be of shorter duration for larger diameters when compared with the natural period of vibration which again is favorable with respect to larger diameters withstanding shock. Without in any way detracting from the value of the data presented, caution is in order in their generalization or in arriving at conclusions, in view of the possible influence on numerical results, of the test configuration and the indicated sensitivity of deformation extent with respect to stress level.

The authors are careful to point out the absence of stress raisers and their potentially potent effect. The specimens carried no longitudinal pressure stress and were very thin; this leads to speculation as to whether thick plates would behave similarly. It is hoped that the authors will be able to pursue this problem further.

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Authors' Closure

The discussion by Messrs. D. B. Rossheim and J. J. Murphy is appreciated very much. Their note of caution probably arises from knowledge that many brittle fractures of engineering structures have occurred at nominal stresses that seem very low, compared to the nominal fracture stress found for laboratory specimens. To explain this difference, either some unexpected weakness of the material in the structure or a source of high stress must be found—from dynamic loading, from notches of some kind (geometrical or metallurgical), or from residual stress. Generally, the explanation also requires the assumption of low ductility.

We have shown how to analyze the case of dynamic loading, for the simple geometry of a smooth pipe subjected to a gaseous detonation, to get values of stress and strain rate at the instant yielding begins. The results of the tests agree fairly well with published evidence that high strain rate raises the yield point of mild steel. They predict that vessels burst by dynamic pressure loading will develop high nominal stress before fracture, unless they contain severe stress raisers or residual stresses.

With regard to the effect of the plate thickness on yield and fracture stresses, the effects of detonations on vessels were studied first in the investigation of the bursting of refinery vessels. In our opinion, these vessels also developed high stress before fracture. At present, no further studies are contemplated.