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AN INVESTIGATION OF THE STRENGTH OF THICK-WALLED PIPES

by
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Investigations of substances under a high hydrostatic pressure are usually carried out in thick-walled steel vessels -- pipes. In this research, when operating at pressures above 1,000 atm., the pipes used are of fairly large size. Theoretical calculations /1,2/ indicate that when the internal pressure is sufficiently high, the elastic stresses on the wall material, no matter how thick, can always exceed the permissible limit. Therefore, for every material there exists a definite limiting pressure above which the pipe cannot be used, as otherwise plastic deformation would begin, first, of the inner, and then of the outer pipe layers, culminating in the rupture of the pipe.

In many cases it is extremely important to determine the magnitude of the maximum internal pressure at which such a rupture occurs. The usual assumption is that the pressure at which a pipe ruptures depends mainly on the thickness of the pipe and the strength characteristics of the pipe material /3/. This assumption requires experimental verification, however.

For this purpose, the Laboratory of the Physics of Superhigh Pressures of the Academy of Sciences of the USSR has investigated the strength of thick-walled pipes subjected to superhigh internal pressures, up to 14,000 atm.

It should be noted that similar research on the strength of pipes made of carbon steel (0.28% C) under pressures as high as 7,100 atm was recently conducted at the University of Bristol by Crossland and Bones /4/.

1. Special apparatus was devised for rupture tests of thick-walled pipes subjected to internal pressures up to 14,000 atm. A schematic representation of the installation is shown in Fig. 1. The specimen-pipe 1 is held in split bushings 2 supported by the massive ring 3. The two ends of the pipe are connected to the cylinders 4 and 5 in which the high hydrostatic pressure is created.

The cavities of cylinders 4 and 5 and of the tube interior were first filled by a hydraulic compressor up to a pressure of 3,000 to 4,000 atm. The subsequent further rise in pressure was produced by the travel of piston 6 in cylinder 5; this travel was effected by feeding fluid to the lower cavity of cylinder 7. Fluid was fed to the upper cavity of cylinder 7 for the return strokes of pistons 6 and 8.

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