pressure curve the shape of a square wave. The upper limit is determined by the pressure p_u of the gas in the left part of the limiter; the lower limit is determined by the pressure p_1 in the right part. P_u is 1.5–2 times higher than the vapor pressure of the working liquid; P_1 is of the order of 10 atms. less than the vapor pressure of the liquid. When the plunger is in the lower part of the cylinder, as indicated in the drawing, the membrane M_2 is pressed against the right screen, the membrane M_3 is found in some middle position and the pressure in a system is equal to P_1. When, however, the plunger is in the upper position, the membrane M_3 is pressed to the right screen and the membrane M_2 is in a neutral position. The pressure in the system now is equal to P_u. The relation between the time of compression and the time of decompression can be changed by changing the amount of working liquid in the chamber or the amount of water in the limiter. The pressure curve taken using a condenser manometer has been observed on an oscillograph.

Bubbles which do not collapse during the compression, rise to the trap 4 which is cooled with dry ice; there they collapse.

The adjustment of the chamber was made using a cobalt 60 γ-ray source and cosmic rays. Figure 2 shows one of the first photographs taken of such tracks with the flash initiated by a counter telescope.

The chamber, in the basement of a two-story building, registers on the average 5 cosmic ray particles each minute. A rough efficiency calculation gives the value 0.1.

A more detailed description of the construction of the apparatus will be published later.

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Some Properties of Rotating He II

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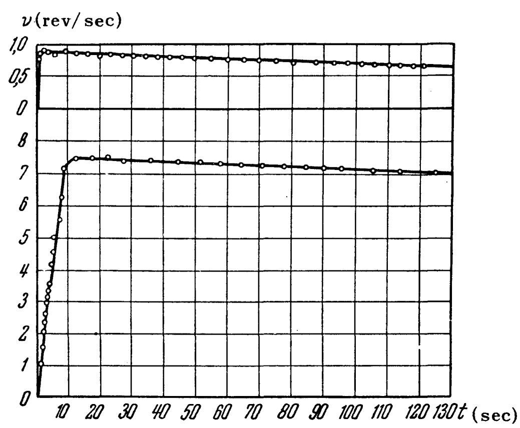
As is well known, it has been established experimentally that for oscillatory motion of a stack of discs in He II[1] only the normal component is entrained, while for rapid uniform rotation of a vessel containing He II[2] the liquid rotates as a whole. The results of these experiments have been explained in papers by Landau and Lifshitz[3] and by Feynman[4], according to which the condition of thermodynamic equilibrium for a rotating vessel filled with He II corresponds to entrainment, not only of the normal component, but of the superfluid as well; in addition, He II must have a moment of inertia which varies with the velocity of rotation from a value corresponding to entrainment of the normal component alone to a value corresponding to rotation of the liquid as a whole[5]. However, as follows from the papers cited above[4], entrainment of the superfluid component must occur at velocities smaller than those encountered in the experiments with stacks of discs, and the fact that this effect has not been observed might be explainable on the basis of an appreciable relaxation time. It would therefore be most desirable to verify experimentally the dependence of the moment of inertia of rotating He II upon the angular velocity, and to attempt to determine the relaxation time.

To resolve this question, the rotational damping of a vessel filled with He II was investigated under conditions approximating as closely as possible continuous equilibrium between the normal and superfluid components. Since the relaxation time was unknown, it was necessary for the rotating system to suffer as little damping as possible. To insure this, the method of suspending a plexiglass beaker of He II in a magnetic field was used, permitting the beaker to rotate for several hours after receiving an initial angular velocity of a few revolutions per second. The beaker (R = 1.5 cm) contained approximately 300 light aluminum discs separated by distances smaller than the penetration depth for the viscous wave. The angular velocity of the beaker of He II was raised in a few seconds to the desired value by means of a rotating magnetic field, which was then turned off. Initially, under these conditions, only the normal component of the He II should be drawn along by the discs, while after the relaxation time had elapsed the superfluid component would be entrained as well. If the relaxation time exceeds the time required to set the vessel into rotation, then, depending on the degree of entrainment of the superfluid component, an appreciable change in the moment of inertia of the beaker of helium (roughly 25%) would be expected, leading to a change in the velocity of rotation. A study of the rotational damping of the beaker of He II, however, demonstrates the absence of any significant change in velocity; this is illustrated in the Figure, in which the variation of the angular velocity of the beaker with time is shown for $T = 1.5^\circ$ K and for starting times of 10 sec (lower curve) and 2 sec (upper curve). From this it may be concluded that the relaxation time must be less than 2 sec. These same experiments permit determination of the variation in the moment of inertia of He II with rotational velocity. It is found that for velocities greater than 0.5 rev/sec there is no such variation. This latter result is in excellent agreement with the results obtained in the experiments with a stack of discs oscillating at large amplitudes[6].



Thus, the absence of entrainment of the superfluid component in the experiments, using an oscillating stack of discs with small amplitudes cannot be explained on the basis of a long relaxation time. The question of the possibility of a velocity-dependent relaxation times, which was brought to our attention by L. D. Landau, as yet remains open.

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