concepts, Post evolved an approach which has come to be called the "Mirror Machine" which uses various applications of the magnetic mirror principle in its operation. In this magnetic mirror machine the ions are spiraling along magnetic lines between two regions in which the magnetic field is more intense and where the ions are reflected. This kind of machine is now under study at the Radiation Laboratory, at Oak Ridge National Laboratory, and at Los Alamos.

A COMPARISON OF THE APPROACHES

Each of these proposals have their peculiar advantages and their peculiar difficulties. The pinch effect is based on an earlier idea of Willard Bennett[3] who derived the relations according to which a violent gas discharge will contract to a narrow filament under the influence of its own magnetic field. The great virtue of this scheme lies in the fact that starting from a rather moderate plasma density one can push the system to very much higher densities and pressures and at the same time expose the containing system to much more moderate pressures. One price that one has to pay is that the high densities are obtained only for short periods. In other words, we are dealing with a pulsed machine. In order to avoid instability and breakup of the pinch, the original simplicity of the concept had to be compromised by introducing magnetic fields parallel to the direction of the plasma current. The detailed theory of the pinch contraction as well as the theory of pinch stabilization was worked out by M. Rosenbluth in Los Alamos.

Rather early in the game it was noticed that the pinch effect in deuterium gives rise to copious neutron emission. The first public announcement of this fact was made by I. V. Kurchatov.[4] Unfortunately these neutrons do not appear to be of thermonuclear origin. Considerable progress has been made by S. Colgate in explaining the mechanism by which these neutrons are produced. A general difficulty in the pinch effect seems to arise from the circumstances that during the formation of the high current filament most of the original energy output is lost to the walls. It seems of the greatest importance to understand and prevent these losses.

The Astron is based on the following observations: In contrast to the instability of the pinch current it is expected that a current of relativistic electrons will be stable. If this proves to be correct one can confine a plasma in the field which encircles this relativistic current for a longer period. This arrangement is under development in Livermore.

The thorough theoretical studies of the stellarator, carried out by Spitzer, Kruskal, Frieman, and others, led to the recognition that the simplest arrangements of magnetic lines are unstable in this case also. In order to prevent these instabilities, additional magnetic fields are being introduced in a direction perpendicular to the original fields. Thus the present pinch and stellarator designs are no longer as sharply different as they used to be. However, the stellarator continues to be a device in which steady-state operation will be attempted and in which the main magnetic fields will originate in a region outside the plasma. The problem of heating the plasma in the stellarator has turned out to be a rather difficult one. The first step in the heating process is by ohmic current, but soon the conductivity of the

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