April 20, 1959

Mr. H. Gordon Howe
Research Corporation
405 Lexington Avenue
New York 17, New York

RE: Multiple Anvil High-Pressure, High-Temperature Apparatus.

Dear Mr. Howe:

The Tetrahedral Anvil Apparatus design allows higher pressures to be obtained than any other multiple anvil design. Anvils when used at very high pressures will ultimately fail due to cracking and breaking. Lifetime before failure is a function of the pressure to which they are subjected and also to the time of cycling. Thus the number of runs obtainable for a given cycling time decreases the higher the pressure utilized and the maximum pressure that an anvil will achieve is usually given as the maximum pressure that will cause a new set of anvils to fail during the first run. The Tetrahedral Anvil device, then, as has already been mentioned, is capable of reaching a higher pressure than any other multiple anvil arrangement and if used at reduced pressure will give the longest lifetime before breakage of any multiple anvil arrangement.

Other multiple anvil arrangements, however, may have some advantages over the Tetrahedral Anvil when used at lower pressures. A particularly useful multiple anvil arrangement is one in which three or more anvils are equally spaced about an axis. These anvil are caused to move along a line perpendicular to this axis by mechanical or hydraulic means. Two opposing anvils are located along the axis and are caused to move together or apart along this axis by mechanical of hydraulic means. Such arrangements are shown on the enclosed sheets numbers 1, 2, 3, and 4. It is usually desirable in these devices to have the dimensions of the anvils (all the anvils surrounding the axis) to be longer in the axis direction than in a plane perpendicular to the aixs. Thus on sheet 2, dimension l_1 is usually greater than dimension l_2. These multiple anvils, when brought together, will enclose a volume whose shape of course depends on the number of anvils used. A similar cell arrangement to that used with the Tetrahedral Anvils would be used with the anvils pictured on the accompanying sheets. For example, sheet 5 depicts a suitable cell

for use with the anvils pictured on sheet 2. As is the case with the Tetrahedral Anvils the linear dimension of the cell shown on sheet 5 will be approximately 25% larger than the linear dimension of the anvil faces. Thus, l_1' and l_2' of sheet 5 will be 25% longer than the corresponding l_1 and l_2 of sheet 2 and because of the symmetry involved other linear dimension will be correspondingly longer.

Although the anvil bases in the accompanying sketches are shown as angular shapes it would be possible to obtain somewhat higher pressures with a given multiple anvil arrangement if the anvil bases were made of circular cross section (as is done in the Tetrahedral Anvil) and were surrounded with a tightly fitting binding ring in order to give the anvil base lateral mechanical support.

In these multiple anvil designs it would be necessary, of course, to provide a supporting frame work to properly position the hydraulic rams that would be utilized to drive the anvils in and out. This frame work would, of course, also be required to support the tremendous forces developed by the driving rams.

A primary advantage of multiple anvil arrangements as shown in the accompanying sketches is that a sample heating tube may be used in which the length of the tube is much longer than the diameter and this is accomplished without making the overall dimensions of the cell disproportionately larger. For example, it might be desirable to subject a specimen one quarter inch diameter by one foot long to high pressures and high temperatures. This could easily be accomplished in a multiple anvil design of the type herein described but would be rather impractical in the Tetrahedral Anvil device because the size of the device required would be so tremendous (of course if it were desirable to submit such a specimen to the highest pressures obtainable it would still be necessary to use the Tetrahedral Anvil device, but in cases where lower pressures would be satisfactory the multiple anvil devices herein described would be much more satisfactory).

This letter is intended as a patent disclosure letter. If I have not disclosed the invention clearly enough please feel free to ask any questions that you might have concerning it.

Very truly yours,

H. Tracy Hall
Director of Research

HTH:pd