Water-cooled Corvair engine offers a technical delight

The 1966 Corvair Monza appeared to be in almost factory stock condition as it sat in Lloyd's garage. Only the twin exhaust pipes exiting through the rear grill gave a hint of the unusual engine I was about to see. The owner told me of his water-cooled Corvair engine design as we walked toward the car. Despite the fact that I had previously heard of his work, I was totally unprepared. Not just a water-cooled Corvair engine, but a technical marvel of engineering and innovation.

The designer and builder is Lloyd M. Taylor. Lloyd pioneered an engine fabrication technique for the 1947 Crosley automobile. Instead of a cast iron block and cylinder head, the Crosley 4-cylinder engine was made from sheet steel which was cut, formed, and welded together. This same fabrication technique was used to make the six water-cooled cylinder/cylinder head assemblies for use on his Corvair engine. These assemblies, designed and built by Lloyd, can be seen in the accompanying photos. They are made from sheet steel pieces which have been cut, stamped and formed to fit. When all the pieces of metal are thus shaped, they are held in a fixture and furnace brazed (welded) together using a special process that Lloyd has developed. Basically, all the parts are held in place and passed through a 2100 degree F furnace on a conveyor belt to complete the brazing operation. The partially completed cylinder assembly (without the outer water jacket) is shown in photos 10-13. Welding the outer water jacket in place finishes the individual cylinder assemblies. These may be seen in photos 8 and 9, and also in photo 4.

Lloyd's Corvair engine is a 1963 he got from a junk yard to rebuild without disabling his car. The engine is a mixture of stock and specially made parts. The entire lower end of the engine is essentially stock, except for a mild aftermarket camshaft and .060" oversize pistons giving a displacement of about 151 cubic inches. Lloyd eliminated the Corvair fan, top shroud, cylinders, intake system, and exhaust system. He removed the valve rocker box portion of each cylinder head which houses the valve rockers, and discarded the rest of the Corvair heads. A new water-heated intake plennum was designed and built for a single centrally mounted two-barrel carburetor. This intake plennum also serves as a new top cover for the engine. Six individual intake pipes, one for each cylinder, were made. The alternator was relocated to allow it, and the new water pump to be driven by a V-belt traveling in a single plane. The water pump and housing are mounted just below the alternator (see photo 6). Twin water distribution plennums (photos 6 & 7) distribute the water to the six cylinders. A new set of exhaust headers was built to handle the relocated exhaust ports which are now located at the top of the cylinders, just adjacent to the intake ports. Normal Corvair exhaust exits at the bottom of the cylinder head. A separate muffler is used for each cylinder bank.

The combustion chamber is not specifically Corvair, but is Lloyd's own design based upon VW combustion chambers. Extra large GM valves are used to accomplish a free flowing entry and exit. The cylinder and combustion chamber

PHOTO #1 - Lloyd M. Taylor's almost stock-appearing '66 Monza with a water-cooled engine. (Bob Helt photo)

are an integral design (being brazed together) which eliminates the standard head gasket. This integral design is common aircraft engine design practice and was also used on the experimental Corvair engine described by Ron Nordquist in *CORSA Quarterly*, Vol. 7, No. 1.

After the three fabricated cylinder/head assemblies are bolted in place on each bank with bolts replacing the head studs, the modified valve rocker box (removed from the Corvair head) is bolted in place. Photo 8 shows the three mounting points per cylinder assembly. The valve stems (not shown but placed in the two larger holes) will protrude into the valve rocker box. Photos 4, 5 and 7 show the mounted rocker box with valve cover in place.

The radiator is mounted up against the air intake at the front of the engine compartment as shown in photos 1 and 3. An electronically-operated cooling fan is thermostatically controlled by the coolant temperature. Coolant is circulated by a belt driven pump to right and left side distribution plennums which direct the water to the six cylinders. Coolant exiting the cylinders is gathered in the intake plennum to heat it for better mixture distribution and then is sent to the top of the radiator for cooling.

Lloyd has put about 7,000 miles on his water-cooled Corvair engine and reports exceptional performance. He regularly gets 23 MPG in the city and 33 MPG highway. The engine has an 11:1 compression ratio, and performs satisfactorily on unleaded regular without detonation. He attributes this ability to run detonation-free to his unique fabricated steel design which has uniform metal thicknesses that can be uniformly cooled. By contrast, a cast iron block and head has large variations in metal thicknesses which cause non-uniform cooling and thus hot spots. According to Lloyd, these hot spots are the cause of most detonation problems. Thus in his design, thinner and more uniform metal dimensions promote better cooling which eliminates hot spots. The elimination of hot spots reduces the tendency to detonation and allows the use of higher compression ratios then would be possible in a cast iron design. High CRs means greater power and engine efficiency.

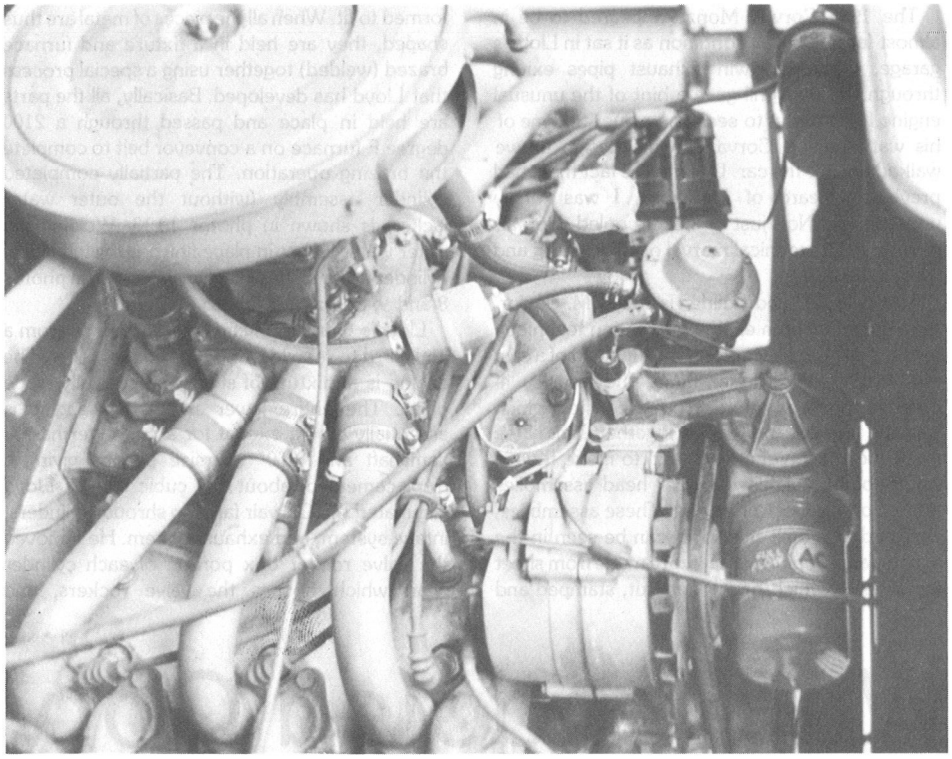

PHOTO #2 -- Showing the water-cooled Corvair engine. Note the specially fabricated six-runner intake manifold with centrally mounted two-barrel carburetor. The alternator has been repositioned. The water return to the radiator from the water-heated intake manifold can be seen just below and to the left of the air cleaner. (Bob Helt photo)

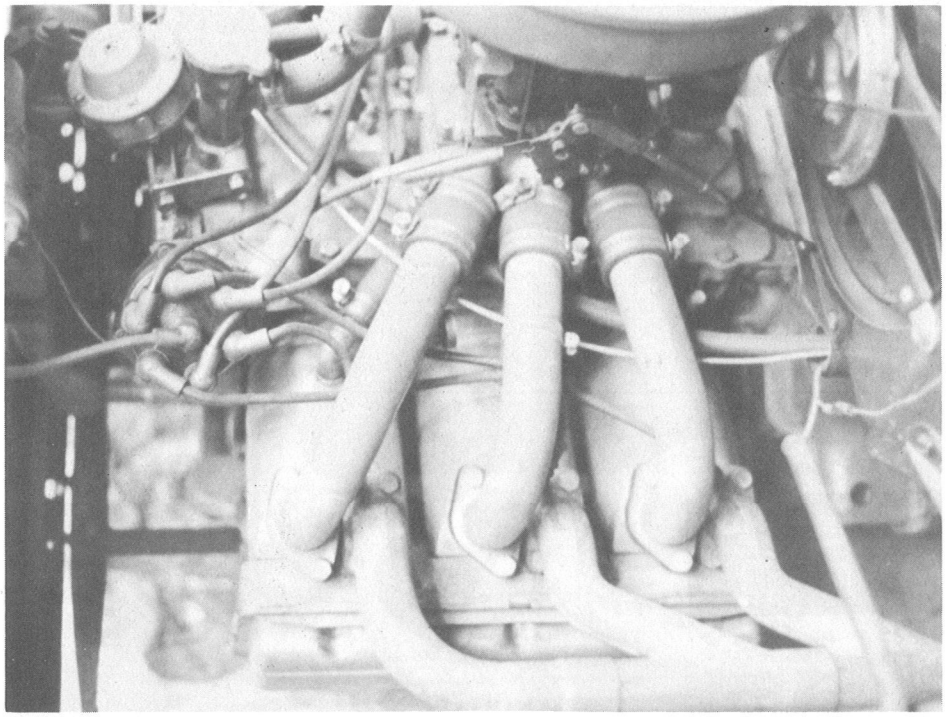

PHOTO #4 -- The three separate watercooled cylinders on the right bank can be seen. Three individual intake manifold tubes-one for each cylinder-run from the carburetor to the top of the cylinders. The exhaust exits the cylinder also at the top and is routed to twin manifolds via a specially fabricated manifold. Exhaust exits at the bottom of the head on the standard Corvair engine. (Bob Helt photo)

Lloyd's 151 CID Corvair engine produces a substantially flat torque curve of 150 lb-ft from 3500 RPM. Horsepower starts high and rises to a remarkable 198 HP at 7000 RPM. At 5200 RPM his engine puts out one HP per cubic inch displacement.

Total engine weight including radiator and coolant is only 250 lbs. according to Taylor. The stock Corvair engine weighs approximately 326 lbs. for comparison. Taylor claims that a fabricated steel engine of given size and displacement would weigh about two-thirds that of its cast iron brother. It would also be capable of producing more horsepower due to its ability to run a higher CR without detonation.

Lloyd has also built a 4-cylinder fabricated steel Chevy II engine which is installed in a 1958 MGA and driven daily. It also exhibits the same low weight and high performance characteristics of his Corvair engine.

As mentioned earlier, Lloyd is no stranger to fabricated steel engines, having designed the 4 cylinder fabricated steel engine used in the Crosley automobile from 1947 to 1952. He feels that fabricated steel engines offer benefits of lower weight, lower production costs, greater efficiency through higher usable CRs, and lower exhaust NOX emissions because hot spots have been eliminated. His two running engines provide real-life proof to his claims.

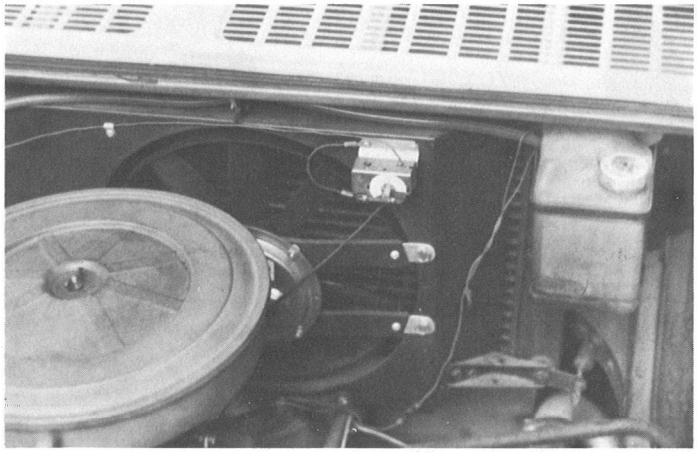

PHOTO #3 -- This photo shows the location of the radiator and cooling fan. The fan is electrically operated and thermostatically controlled. Note the coolant overflow tank. (Bob Helt photo)

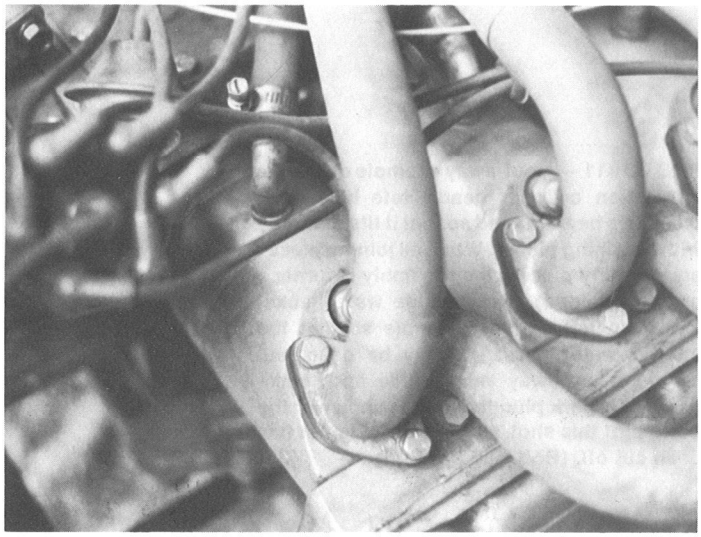

PHOTO #5 -- A close-up of the right bank showing the intake and exhaust manifolding for each cylinder. The spark plugs are partially hidden but can be seen behind the intake runners. Photo #2 also shows the spark plug locations. The water exit tubes can be seen on top of the cylinders just under the plug wires. These tubes carry the coolant to the water-heated intake manifold before returning to the radiator. (Bob Helt photo)

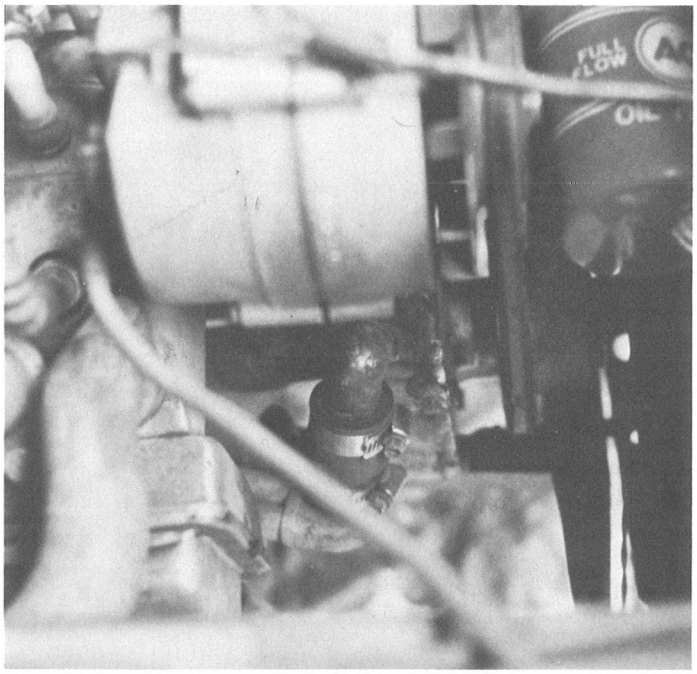

PHOTO #6 -- The water pump and water distribution plennum are shown in this photo. The pump is right below the alternator. Spark plug location can also be seen. (Bob Helt photo)

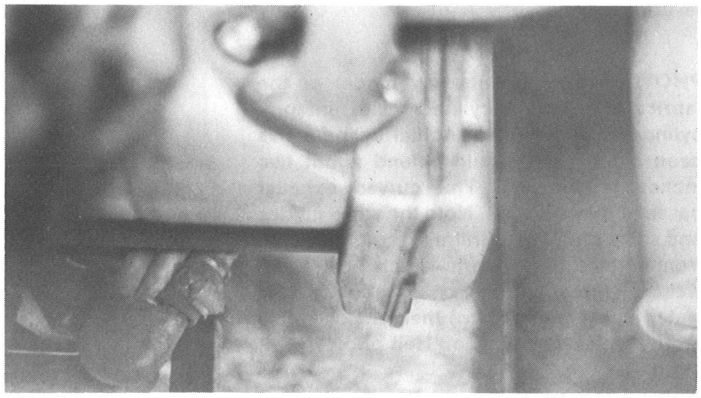

PHOTO #7 -- The water distribution plennum for the right bank can be seen in the lower left portion of the photo. Note the pushrod tube. The rocker box and rocker cover from the old Corvair head can also be seen. Note that since the combustion chamber is part of the specially-fabricated cylinder, only the rocker box portion of the old head is needed. (Bob Helt photo)

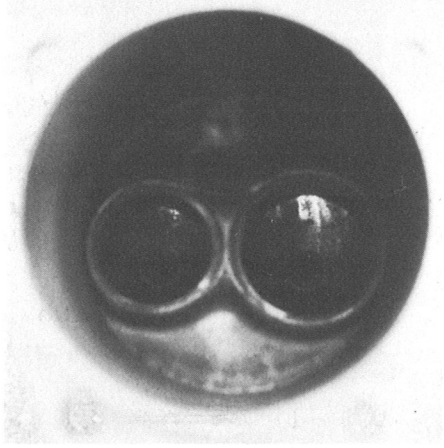

PHOTO #9 -- A view of the combustion chamber in the specially-fabricated Corvair cylinder. Note that the combustion chamber design is not Corvair. (Bob Helt photo)

PHOTO #12 -- A combustion chamber view of the cut-away metal fabricated Corvair cylinder and cylinder head. (Bob Helt photo)

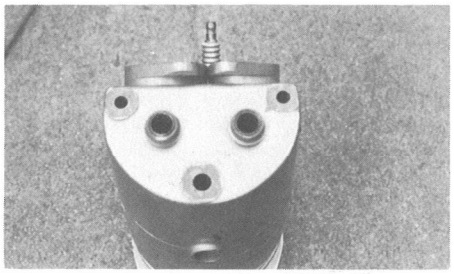

PHOTO #8 -- A top view of one of the specially-fabricated Corvair cylinders. This cylinder includes an integral combustion chamber. Note the spark plug and mounting pads for the intake and exhaust manifolds. Hole shown at the bottom of the photo is the water inlet. The two larger holes at the top of the cylinder are for the intake and exhaust stems, while the three smaller holes are for mounting the rocker box removed from the old Corvair head. (Bob Helt photo)

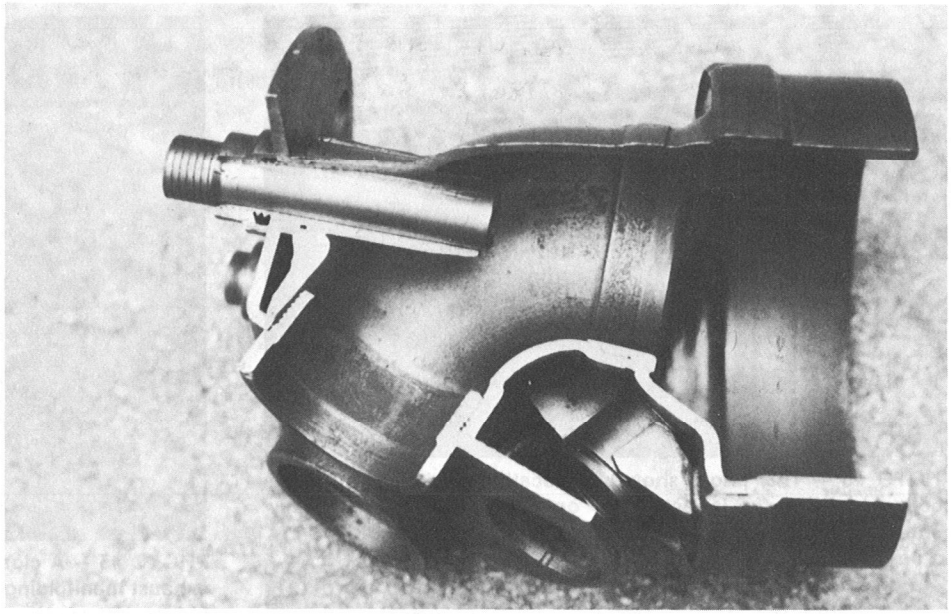

PHOTO #11 -- A cut-away example of a metal fabrication cylinder head. Note how each piece has been formed so that it fits perfectly with adjoining pieces. When all joining pieces are properly placed, the assembly is furnace brazed (welded). The outside water jacket has been left off this example so that the interior water passages may be observed. Note the cut-away valve guide and intake passage. Spark plug location is shown at the bottom of this shot. Most of the cylinder has been cut off. (Bob Helt photo)

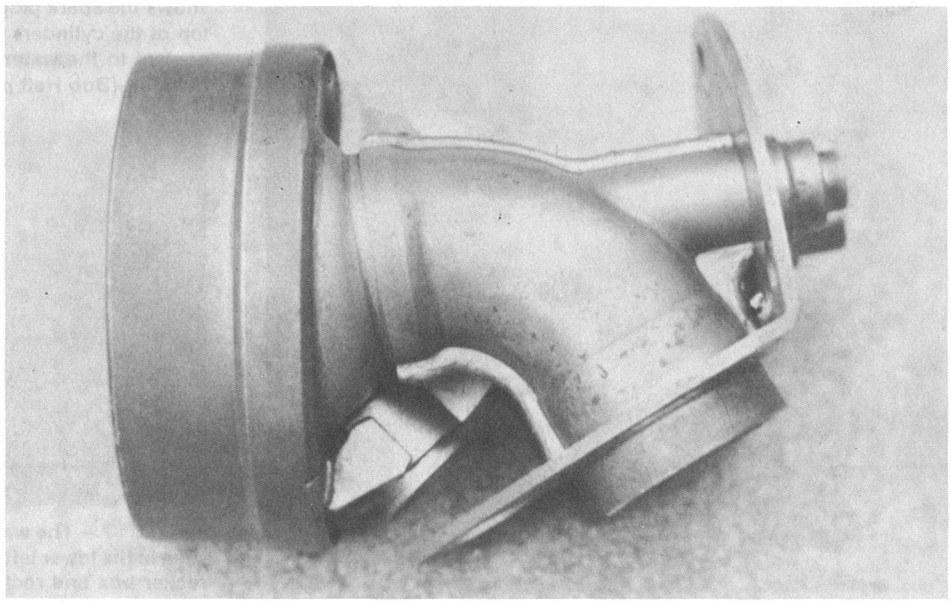

PHOTO #10 -- A cut-away model of the fabricated Corvair cylinder with integral cylinder-cylinder head. Actual cylinder has been cut off but would extend about five inches to the left. The curved exhaust passage may be seen. Note the valve guides and spark plug boss. Entire assembly is made from formed metal parts which have been welded (furnaced brazed) together. Outer water jacket (not shown) then encloses this fabricated assembly. (Bob Helt photo)

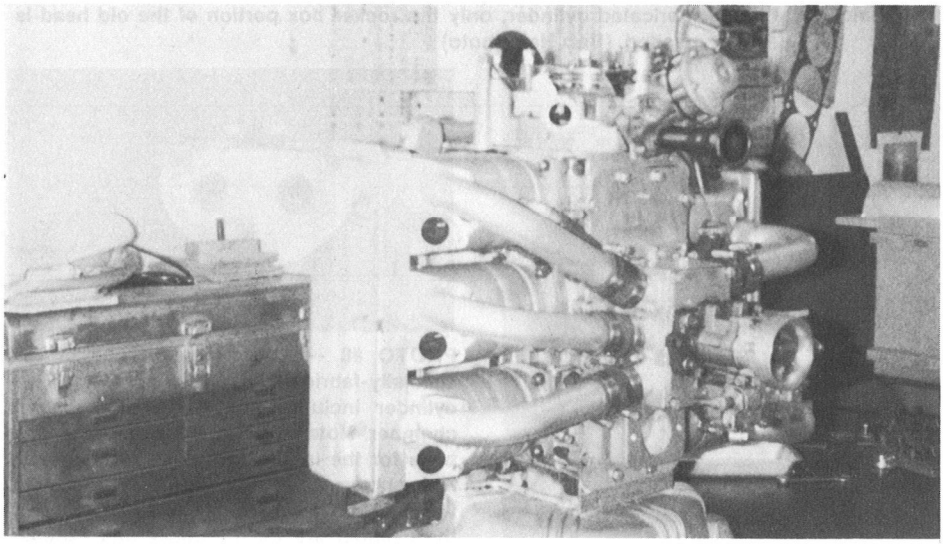

PHOTO #14 - Assembly of the water-cooled Corvair engine showing individual cylinder-cylinder head units. Note the intake manifold runners and open exhaust ports. (Lloyd Taylor photo)

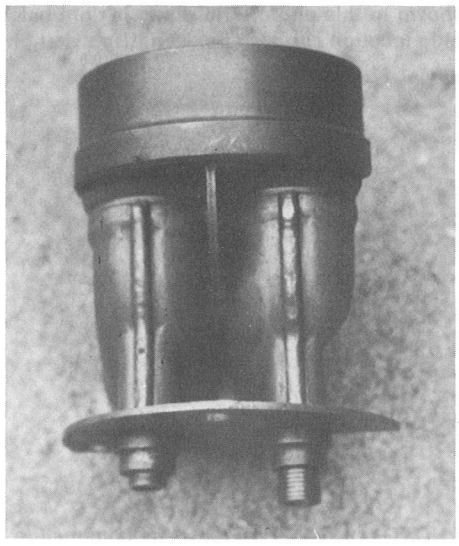

PHOTO #13 -- Another view of the cut-away metal fabricated Corvair cylinder and cylinder head assembly. (Bob Helt photo)