ENGINEERING

Setting the World to Streamlines

Automobiles, Aircraft, Rail Trains and Water Vessels Make Greater Speed on Less Power through Proper Design

By CAROL NEWMAN, JR.

SUPPOSE you are speeding along the highway in your present-day automobile of conventional body design at 60 miles an hour.

Then imagine that a sudden transformation comes over your car. Its engine is moved to the rear. The flat radiator is rounded off and the headlights and fenders sink into a smooth bulging front. The squared-off rear is drawn out in a long, sharp taper.

Now look at your speedometer. Instead of going sixty, you are making seventy-five miles per hour and you haven't shoved the accelerator down a fraction of an inch farther. Your speed has increased from sixty to seventy-five miles per hour without an increase in gasoline consumption. Road tests show that even imperfect streamlining will bring about such an increase in speed.

This imaginary transformation typifies one of the chief results of streamlining. And it is a vision that gives promise of fast becoming a reality.

Streamlining will have other effects on your car.

If it is streamlined properly you will soon find that you are driving 35 to 40 miles on every gallon of gas, or at least twice what your mileage is with the old shape. Walter T. Fishleigh, consulting engineer of Detroit, vouches for the accuracy of this statement. He also deplores the old fashions in automobile designs. He sees a ridiculous likeness in general form between the modern auto with its engine in front and the horse-drawn milk wagon of twenty years ago.

Tests have actually proved that the present automobile, with its square back and numerous projections, is built to be held back by air about as much as a moving body could be.

Quite a stir has been created recently over the possibilities of the "tear-drop" car, it being popularly believed that a falling tear or drop of rain takes the form of the perfectly streamlined body. Dr. H. L. Dryden, aerodynamics expert of the U. S. Bureau of Standards, intimates that too much faith is placed in the infallibility of the tear-drop form.

"As a matter of fact," he says, "any body shaped without the steep curvatures which cause wind eddies is really streamlined. The 'tear-drop' form is not, from a standpoint of streamlines, necessarily the best."

Dr. Dryden cautioned that a superficial streamlining, such as smoothing off of square edges, will not bring results. Automobiles, he said, must be remodeled according to definite principles formulated from actual tests.

Fixed by Air Resistance

He also said few motorists realized that the maximum speed of the ordinary car is definitely fixed by air resistance. At speeds of over 40 or 50 miles per hour the resistance of the wind forms practically the only obstacle to overcome, and thus a lowering of this resistance would mean a corresponding increase in speed. This fact is little short of astounding when one remembers that with streamlining it is possible to cut this resistance in half.

Equally illuminating is Dr. Dryden's statement that the so-called streamlined body which will produce double mileage on a gallon of gas, actually encounters ten times the resistance of the perfectly streamlined body. This difference leaves a superlative goal for the future, which if only approached might mean riding a 100 miles or more on a gallon of gas!

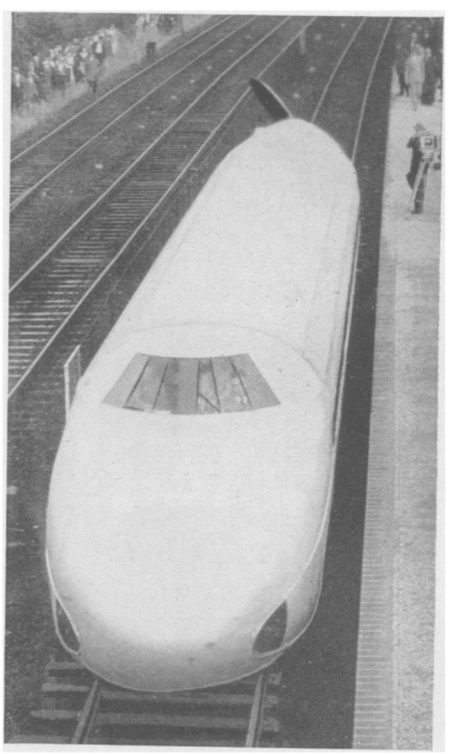
Streamlining in automobiles involves a number of radical changes, beside that of the shape alone. It means placing the engine to the rear of the passengers, swinging the seats low between the axles, and reducing the cross-sectional area of the car body. Streamlining is calculated to make driving easier and more economical because of a simpler construction of automobile parts. Dust clouds will be absent behind the moving car as a result of the smooth air currents.

Already trucks on at least six freight lines in California have been able to carry cargo up to the legal weight limit with little increase in gasoline consumption. This was possible by making the front ends of the trucks smaller, which cut down the air resistance. Drivers found they could tell which direction the wind was blowing by simply checking the amount of gasoline used.

Automobiles with streamline features are not uncommon along the highways of Germany. In England, also, streamlined cars are beginning to be seen. Not long ago the first examples of Sir Denistoun Burney's "airship model" automobile made its appearance on English roads. Crowds of people were astonished at the gracefully curved machine with its one-piece body and engine in rear. Though the car develops but 22 horsepower actual highway tests show it can attain a speed of 80 miles per hour. In other countries as well streamlining is being looked to hopefully.

But automobiles are only a part of the streamline story.

There is hope for cutting the annual coal bills of all express trains in France by one-third through the application of



RAIL ZEPPELIN

Streamlined to look like a huge fish and driven along by a propeller at the rear, this German creation recently set a speed record of 143 miles per hour.

streamlining. Experiments performed by M. Charles Maurain, of the Aeronautics Institute of Saint Cyr, have led to the conclusion that air resistance forms at least a third of the total resistance encountered by a train, and consequently properly styled cars would mean a saving on French systems of well over a million tons of coal yearly.

Hidden Smokestacks

Several trains on the continent have already been streamlined to a certain extent. One in northern France, the "Golden Arrow," presents a curious appearance, with its coaches tight end to end and a shining aluminum cone projecting at the rear. Even in the United States engines with hidden smokestacks, built-in headlights and smoothed-off corners can be seen.

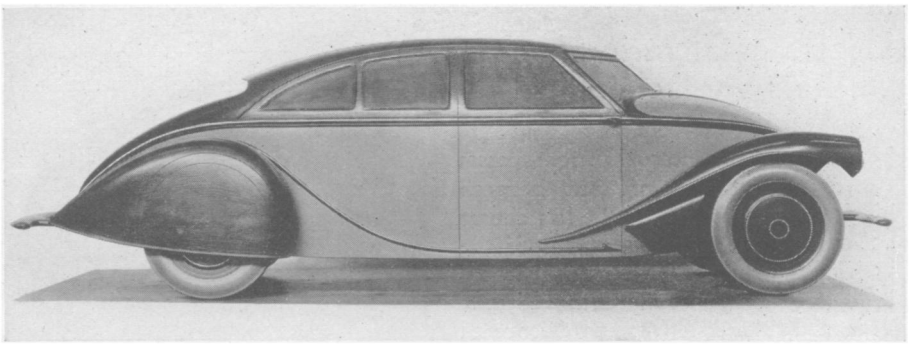
Tests are being conducted with models in the Westinghouse Research Laboratories to determine the effects of streamlining as applied to high-speed express and interurban trains. Chief among the investigators there is Dr. O. G. Tietjans, whose experiments have prompted his belief that streamlining for express trains will reduce wind resistance by two-thirds and the total train resistance to one-half.

While streamlining is less important to heavy trains at low speeds, Dr. Tietjans found that if the proper design were given the present light interurban train, the total horsepower required to drive it at a speed of 75 to 80 miles per hour could be reduced by more than half.

Styles of revolutionary character for high-speed trains are expected to be worked out as a consequence of these tests, making the trains notable for their efficiency and economy of operation. The application of streamlining to railways may not be as extensive as in the case of airplanes, but the work already done and the fact that a group of the foremost French railway technicians are convinced of the practicability of streamlining constitute some indication of its future in the railway field.

Back about 1910, when man first began exploring the sky, streamlining got its first real trial outside of nature. Here resistance was all of an aerodynamic sort, and it was soon found that the original box-shaped airplanes wouldn't do.

Just as an example of what skilled design means in the air, Dr. Joseph S. Ames, chairman of the National Advisory Committee for Aeronautics, has said that sufficient streamlining will reduce the resistance of an airplane by two-thirds. Thus any of the giant trimotored ships which fly the passenger lanes of the country could, if correctly designed, leave off two of their engines and still develop as much speed as they do with all three at the present time!



THE "TEAR DROP" CAR

Showing the trend in design which automobiles of the near future may follow.

And the streamline features of the engine hood developed by the National Advisory Committee have increased the speed of the ordinary commercial plane by at least twenty miles per hour, Dr. Ames said.

That airplane designers are cognizant of the importance of streamlining today is shown by the display recently of the British Royal Air Force. New styles calculated to lower wind resistance were illustrated by planes developed in the constant search for more perfect streamlining.

There is still room for much development in streamlining in aviation. Devices such as landing gear and projections about the cockpit increase air resistance 50 per cent. or more and must be done away with or built in, if much higher speeds are to be obtained without some radical innovations in motors.

Projections make such a big difference because a streamlined body is delicately balanced and must head straight into air currents if it is to find the easiest path. Fins on airplanes and racing cars are for the purpose of helping the car or plane maintain this head-on position.

On sea, as on land and in air, streamlining is beginning to make rapid strides. The most important single factor that has enabled power boats to attain speeds of nearly a hundred miles per hour is the changed design of the hull. The old V-shaped vessels that displaced so much water have given way to the flattened-out hydroplane design with the "stepped" bottom, which has tripled the possible speeds of motor boats.

Partial streamlining has been applied successfully to some of the big ocean liners. The "Bremen," which holds the speed record for crossing the Atlantic, presents a striking picture with its oblong stem, cylindrical stacks, and block-shaped bridges.

Among the boats of recent design are those driven by airplane propellers, which may soon speed along all the inland waterways of Germany. They evince more consideration for the air resistance, which is almost as important as the water factor. Bodies that engineers streamline for use in the air have been found to be efficiently streamlined for water operation at low speeds. At high speeds, however, the conditions of resistance vary greatly. A boat moving through the water at 100 miles per hour is having the same resistance troubles that an airplane would face rushing along at 1300 miles!

Streamlined Skyscrapers

But the reach of streamlining doesn't end with objects which move fast. Wind pressures have been studied with the view to streamlining office buildings so they can hold their own against the gales which worry skyscraper tops. Deep in the earth, air passages in coal mines are being streamlined because of the saving in power required to pump the air through them. So the story goes.

The first theories concerning streamlining held that all bodies were streamlined regardless of shape. But after the first tests, this idea was hastily abandoned. Experiments recently made at Langley Field, Va., have shown that a body which is from four to six times greater in length than in diameter is most nearly streamlined. As speeds increase streamlining is found to make a bigger difference. (*Please Turn to Page* 253)

INVENTION

Research Aided by Machine Solving Difficult Equations

New Device, Consisting Entirely of Mechanical Parts, Does Valuable "Thinking" for the Scientist and Engineer

A NEW MACHINE which can solve the complex mathematical problems arising in the course of scientific research has been made by Prof. V. Bush at the Massachusetts Institute of Technology.

The "differential analyzer," as Prof. Bush calls his mechanical thinker, will do for the advanced branches of science and engineering what the adding machine has done for business accounting methods.

When a physicist or chemist makes a guess or forms a theory about a scientific problem, he can often express it in the form of what he calls a "differential equation." This is a collection of mathematical symbols which has a perfectly definite meaning, but yet the scientist cannot test it directly by experiment. The equation must first be "solved."

The result of this process is a solution or "integral" which, though also an equation, has the advantage that all the quantities occurring in it can be measured in the laboratory. The obtaining of the solution often requires a high degree of mathematical skill and much patience.

Prof. Bush's new machine promises to do this difficult and frequently occurring job.

Discussed Two Centuries Ago

The possibility of using machinery to solve scientific problems was discussed in detail two hundred years ago by the famous German mathematician Leibnitz, who invented the differential calculus. Leibnitz's idea was to relegate to the machine those parts of the process of thought which are inherently mechanical and repetitive. But though he was a great genius and inventor he did not have the accurate machine tools, new alloys, thermionic tubes and photoelectric cells now available to the modern engineer.

The present status of physics and engineering is peculiarly favorable to a development such as Leibnitz imagined. The department of electrical engineering of the Massachusetts Institute of Technology has devoted itself to this problem.

The new differential analyzer has already been used to solve problems of electric transmission and has been tested for precision. It consists entirely of mechanical parts. The main problems encountered in its construction have been those of backlash.

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Setting the World To Streamlines

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It can be seen that the matter of streamlining is making many of the automotive world's engineers sit up and think, if they haven't done so already. Streamlining has a wide application, but the idea seems most revolutionary where it concerns the ordinary automobile.

It is hard to realize that if our automobile were properly shaped, it would give us, even at medium speeds, twice as many miles on a gallon of gas. If such a thing is possible, why has it not been put into use years ago?

The answer seems to be that only with the introduction of aircraft have there been possible speeds high enough to justify a consideration of air resistance. Furthermore, it is probable that most automobile manufacturers have been slow to take streamlining seriously because they felt that such odd designs in car bodies would not be popular with the motoring public. At any rate, it is evident that automobile styles have kept the same general outline for almost twenty years.

Extensive streamlining, some authorities say, is not practical at present because long streamlined bodies would waste space within the automobile and make the parking problem even more acute. In contrast, a leading engineer predicts rear-engined streamlined cars for America within the next few years and points to the success Germany has already had with streamlining.

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