ENGINEERING

Engines of the Future

The engines of the future will use new operating principles such as free pistons that "float" in their cylinders, and small engines will lift "flying cars."

By EDWARD HEDRICK

➤ ENGINES of the future are in for some big changes in design and operation. They will be lighter, smaller and more powerful.

They will make use of power sources such as "free" pistons that "float" back and forth in the cylinders, unhampered by connecting rods, with the exhaust gases doing all the work of turning a turbine.

Jet engine gas turbines will be harnessed for their power, and there will be "flying engines" or ducted fans to lift flying vehicles. Even nuclear and solar engines are being studied for ways to make them economically practical power sources.

Possibly the most promising power plant now under study is the "free-piston turbine" engine.

Ordinary internal combustion engines, such as the gasoline and diesel, transform the energy of an exploding fuel-air mixture into mechanical energy through the piston and connecting rod attached to the crankshaft. These conventional engines are usually "V" or "I" shaped, and the whirling crankshaft tends to set up twisting forces on the engine frame, requiring heavy, bulky supports to maintain stability.

The free-piston engine eliminates the connecting rods and twist by allowing the pistons to move freely away from the combustion chamber in opposite directions while the expanding exhaust gases help run a high-speed turbine wheel. The turbine in turn transfers the engine's power to the desired point.

The pistols are cushioned by a layer of air trapped in the rear of their cylinders, and so are "bounced" back toward the combustion chamber again for another engine cycle. The free-piston portion of the engine is called the "gasifier," since it produces the compressed gases used to run the turbine.

Any number of such gasifiers can be connected to one large turbine to increase the power of a single engine. A gasifier can be serviced or repaired while the turbine is running, in this arrangement.

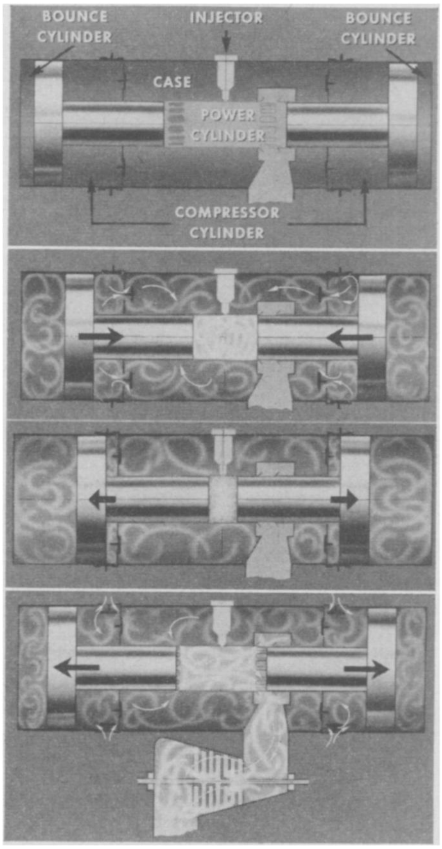
Peanut Oil Burner

A new type of free-piston engine has already been built into a farm tractor by the Ford Motor Company. The motor burns almost any kind of fuel, from high octane gas and diesel oil to peanut oil and some vegetable oils.

It is light in weight, small and compact in volume, and requires no critical or "exotic" metals in its manufacture. At idling speeds the turbine's whine can be heard, but otherwise the noise level is low.

At the present stage of development, there are a few "bugs" that must be worked out of the engine. It is a little too heavy, three pounds per horsepower, to compete with other engines; it is sometimes hard to start and the turbine speeds are too low to provide the high operating speeds industry requires.

When these problems are solved, however, this type of engine is expected to compete in design as well as cost with conventional engines.



FREE-PISTON ENGINE — The operating sequence for the inward-compression free piston engine is shown in this series of drawings. Beginning at the top, with the pistons in starting position and all valves closed, the next steps include: starting air pressure admitted to bounce cylinders, pistons moving inward thus closing ports and compressing air; pistons complete their inward travel, fuel is injected into the power cylinder, combustion starts and power stroke begins; and, further outward movement of pistons opens intake ports, completeing the power stroke.

As an example of the free piston engine's progress in the automotive industry, the General Motors Corporation is now experimenting with a futuristic-looking free-piston-powered car called the "XP-500."

The gas turbine of jet plane fame is also under study as a future power source for industry and automobiles.

The motor has several advantages over conventional engines; it does not need a "warm-up" time, requiring only a spark to start the fuel burning and the turbine turning. It can be made as compact as present engines, runs much more quietly and smoothly and has a cleaner exhaust. Its servicing is simple as it has only one moving part: the turbine. Other parts are as easily serviced as present engine components.

Harnessing the Jet

The gas turbine's speed, power, apparent efficiency, smoothness and lack of noise were attractive to designers, but in studying the engine they ran into some difficulties. The major one was relative size or scaling: they could not build a tiny turbo-jet engine and simply attach it to a machine or car.

Jet planes making use of turbo-jet engines are propelled by hot, expanding gases shot from the nozzle of the jet, while ground machines must be driven by a wheel powered by a "harnessed" jet. This harnessing required many design changes, for example, the development of small-sized turbine wheels that had to operate at temperatures of approximately 1,200 degrees Fahrenheit.

Turbine wheels had to made of special, expensive, high-temperature metals, the larger ones had to be especially cooled, and engine efficiency increased by heat exchangers. All these design features added up to extra bulk, weight and expense of the turbine engine.

These disadvantages are rapidly yielding to designers as, for example, in the General Motors "Firebird" experimental turbo-car, the Chrysler experimental gas turbine Plymouth and the gas turbines now under development for use in future buses, locomotives, electrical generators and ships.

The gas turbine may be the means to change the energy from the splitting atom or the sun into usable power. Both the fissioning atom and the sun give off heat. The gas turbine seems to be the most efficient way of making this heat turn the wheels of industry or producing electric power for cities and communities, designers say.

Nuclear gas turbine power plants for ships, submarines and power stations are now being studied and planned. Present nuclear reactor power sources are not built with gas turbines. They make use of a heat exchanger to make steam for steam turbines.

In the future, nuclear power plants for propelling merchant ships may be the main source of marine power in 10 to 15 years, predicts C.G.A. Rosen of the Caterpillar Tractor Company. Nuclear power for military but not for commercial aircraft is within the "foreseeable future," but he considers the outlook dim for nuclear-powered locomotives and vehicles.

The combination of gas turbine and nuclear power is not expected to be used for cars or military automotive equipment, mostly because of its weight. A nuclear power plant would be saddled with about 20 pounds of reactor shielding per horsepower and this does not include the weight of the engine.

Solar-powered vehicles are still too far in the future to make definite predictions, but designers admit that use of the vast amount of solar energy falling on the earth is not impossible. In the geographical area of the U.S. alone, as much as 2,000 times the daily energy needs of the U. S. falls as solar energy.

Flying Station Wagons

Future cars, buses and lifting equipment may operate in the air, not on the ground, if the "aerial jeep" under development for the Army Transportation Corps becomes available to the public.

The flying cars make use of "ducted fans" to lift them smoothly and easily into the air. Ducted fans are simply propellers with wings wrapped around them. They look like "flying barrels." The prop blast is directed downward, making it possible to lift heavy objects directly, as a helicopter does.

The aerial vehicles are expected to look much like regular cars, but be flatter and wider to accommodate two to four ducted fans located in conventional tire positions. The vehicles, being designed for the Army as personnel carriers, flying gun and observation platforms, flying cranes and rescue cars, are expected to be able to lift 1,000 pounds as high as a helicopter could and travel at speeds of 50 to 60 miles an hour.

One manufacturer, among the four contracted by the Army to develop the "aerial jeep," envisions the future civilian use of the vehicle as the "station-wagon of the future."

The old reliable conventional piston engines are also in for some improvement.

Fuel Injection Predicted

Fuel injection is becoming more popular with manufacturers as better designs make the system more dependable for gasoline-type engines.

While diesel engines rely upon a type of fuel injection as part of their construction, gasoline engines must be especially fitted for fuel injection. The reason is they were originally designed to have the fuel-air mixture from the carburetor sucked into the cylinder by the action of the piston, not forced in as a pressurized, pre-mixed spray, as in the fuel injection system.

Fuel injection is expected to make gasoline engines more powerful for their size and more efficient. The carburetor is not needed, and the engine can be started cold.

Fuels for the combustion engines of the future may have to pack more power in a smaller volume. For conventional piston-type engines, gasoline is expected to be refined up to 110 octane by 1960.

Some buses and trucks are already running on a fuel called "LPG" or liquefied propane gas.

Fuel-grade propane gas is a mixture of hydrocarbons, similar to natural gas. Propane gas is commonly found as the pressurized fuel gas in small hand blowtorches used for soldering purposes.

When liquefied, propane gas can be a highly efficient fuel if it is burned in properly modified internal-combustion engines. The gas burns clean with an almost invisible, odorless exhaust, forms very little engine deposit and does not burn the oil film on the cylinder walls.

Using LPG also saves considerable money. One bus company fueling their vehicles with the gas reports a savings of about $2,200 in fuel and upkeep on each bus.

Making use of better fuels, small size, better efficiency and light weight, industrial power plants of the future will be better fitted to deliver power efficiently and cheaply, with the minimum of maintenance.

Science News Letter, November 9, 1957

A series of *stalactites* in the Luray Caverns of Virginia has been "tuned" by grinding away portions of the surface so that they produce organlike music when struck with rubber-tipped hammers.

MEDICINE

Backaches Come From Unsolved Problems

➤ BACKACHES are mostly caused by failing to come to terms with everyday emotional problems, Dr. T. H. Holmes, University of Washington, Seattle, told the Academy of Psychosomatic Medicine meeting in Chicago.

Controlled tests have shown that too much muscle function and electrical activity usually accompany low back pain, and the pain is always set off after the patient's security has been threatened.

Backache is a reaction that sets in when a person tries to solve a "life situation" and does not succeed, the psychiatrist reported.

Chief causes of these insecurity feelings include conflict, anxiety, frustration, humiliation and guilt. The pain they cause may show up in the back, neck or extremities when these interpersonal and social reactions are not properly dealt with.

Available evidence points to the fact that the element potassium is the pain factor in backache. When intense muscle activity continues there is a gradual accumulation of the chemical in the tissues. After the concentration has become high enough, the pain threshold is exceeded and the result is a common backache.

Science News Letter, November 9, 1957