

The Graphic Laboratory of Popular Science

The Diesel Engine's Story

By WILLIAM SHINNICK

YESTERDAY, March 18, was the eighty-first anniversary of the birth of a man whose greatest accomplishment looms ever larger today in the field of transportation.

On March 18, 1858, in Paris, was born Dr. Rudolph Diesel. His parents were German, and the young man eventually was sent to Munich Technical college, from which at 21 he was graduated as an engineer. Immediately he set out upon a career destined to be crowned with vast success and closed in tragic mystery.



Dr. Diesel

A scientist of great gifts, Dr. Diesel was distressed by the inefficiency of the simple steam engine of his day, which utilized only 6 to 8 per cent of the actual values in its fuel.

Theoretically he worked out the one we now know as the Diesel. He put it on paper. Then he built it. That was in 1892, and his fuel was powdered coal. That first engine blew up and Dr. Diesel narrowly escaped death. But he persisted and in 1897 produced an engine that actually worked. The next year a manufacturer in St. Louis, Mo., built a two-cylinder sixty-horsepower Diesel that was a commercial success. Thus forty-one years ago the Diesel was launched under favorable circumstances.

Its uses at the time appeared limited. For one thing, the Diesel was heavy. It weighed 250 pounds to the horsepower, and it seemed to experts then that it would have to be confined to use in stationary installations or in ships, where the weight factor was not so important as in trains and motor vehicles. In those fields the Diesel did make gains, and Dr. Diesel won a great fortune with his patents.

He was accepted everywhere as a great mechanical genius. He took the world's plaudits modestly, but he was sold on the merits of his invention.

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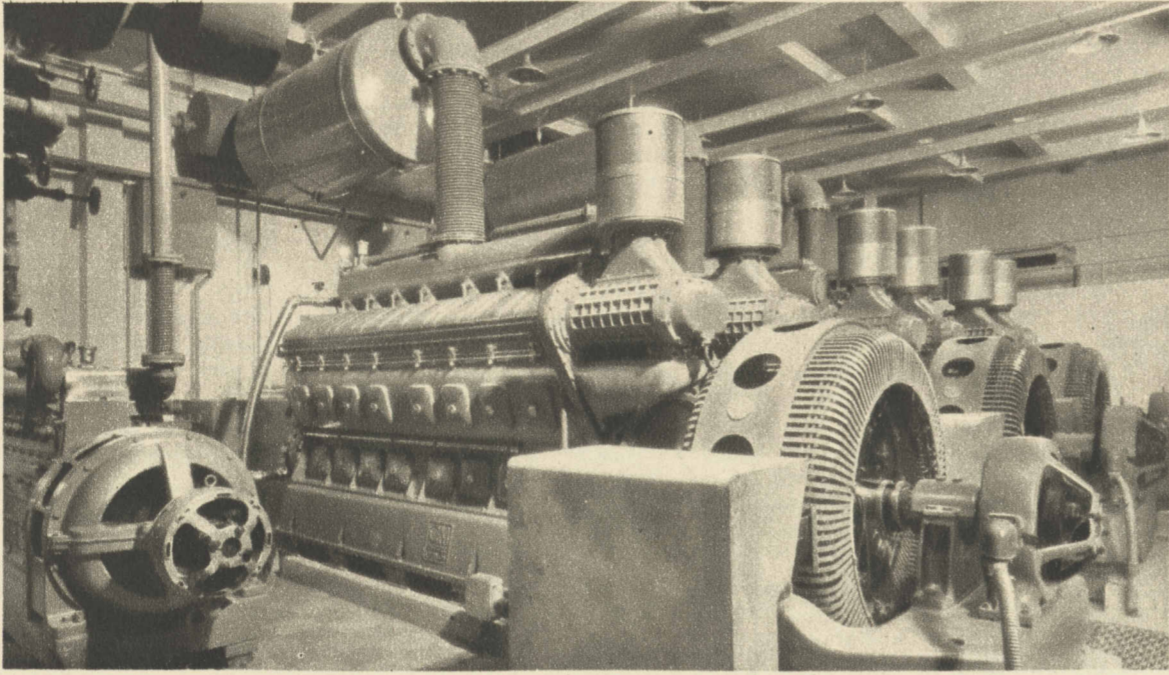
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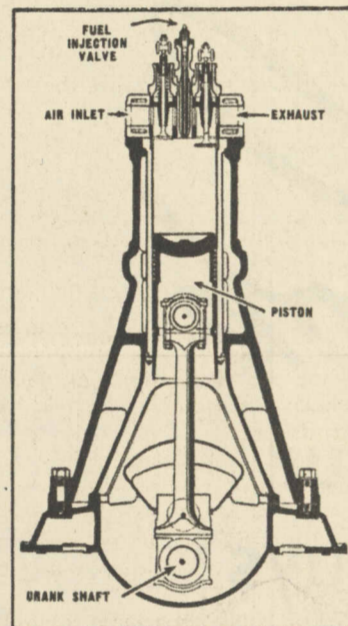


(Photo courtesy Diesel Progress.)

The four-unit Diesel power, light, and air-conditioning plant of a Miami, Fla., office building. The three large engines are sixteen-cylinder, two-cycle, 1,050-h.p.; the small one is eight-cylinder, four-cycle, 225-h.p.

"The Diesel engine," he told the American Society of Mechanical Engineers in 1912, "has doubled the resources of mankind as regards power production and has made new and hitherto unutilized products of nature available for motor power."

Nobody denied this. It was close enough to the truth to be valid, although the gasoline engine was then, as it is now, the main stem of development in the internal combustion power field. The Diesel engine had made many things possible. One of them was that terrible



Simplified sectional view of four-stroke Diesel engine.

weapon of war, the submarine. The Diesel had been a boon to the shipping industry also.

On Sept. 29, 1913, Dr. Diesel boarded the channel steamer Dresden at Antwerp. He had accepted an invitation to attend a meeting of English manufacturers in London. With him he carried important papers.

A veil of mystery is drawn over what happened after nightfall. In the morning when the Dresden docked Dr. Diesel was missing. So were his papers—all of them. His berth had not been slept in.

There was a vast amount of theorizing about what had happened to him—flight, accident, suicide.

In 1917 a German, who had been a member of the crew of one of the Kaiser's submarines during the early part of the war, offered a new version. Dr. Diesel, he said, had been tossed off the ship with deliberate murderous intent.

"He was going to England to talk," the man averred, "and was killed because he knew too much about submarines. He might have talked about them." The mystery remains.

In any discussion of the Diesel engine four questions automatically arise. Where did it originate and what is it? How does it do its work? How does it differ from other ways of turning out usable power?

Answer to the first question we have already noted.

What is the Diesel engine?

It is an internal combustion engine that utilizes the heat of high compression to ignite its charge of fuel, which is introduced into the cylinder after the compression has been attained. In these respects it is much different from the gasoline engine.

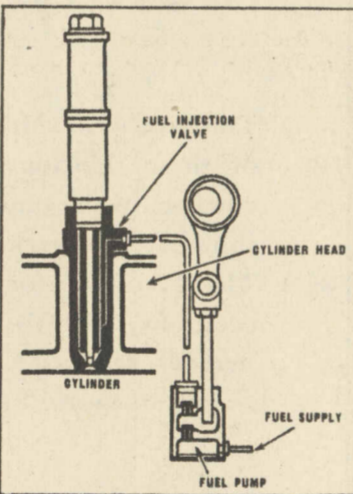
In the gasoline engine fuel and air are first mixed in the proper proportions (fifteen parts of air to one of gasoline) in a carburetor. The mixture is introduced into the cylinder, compressed by a piston, and exploded by a spark.

In the Diesel engine air alone is compressed. Then fuel is injected and starts burning simply because the air has been heated by intense compression. The essential differences of the Diesel are (1) that its fuel and air are mixed under pressure in the cylinder and (2) that it has no ignition system (spark plugs).

The compression ratio of the Diesel is high. That perhaps needs explanation.

Let us assume that the inside of an engine cylinder has a capacity of six pints when its piston is at the bottom of its stroke. Let us assume that the piston moves and at the end of its upstroke contracts the space above it to one pint. The compression ratio of such an engine is 6 to 1, something like normal for a gasoline engine. Six pints of a mixture of air and gasoline are forced into one pint before being exploded.

Let us assume that a Diesel engine cylinder with the piston down holds sixteen pints and



Simplified sectional view of "solid" fuel injector.

that this is forced into one pint space by the piston's up-stroke. We then have a compression ratio of 16 to 1, which is normal for a Diesel. It would not work at all at 6 to 1; it does splendidly at 16 to 1. Why?

If we compress air—sixteen pints into one pint—that air gets very hot. It reaches 1,000 degrees F., about the temperature of the top of a red-hot stove. We now have the air in the Diesel cylinder heated. The next step is to introduce fuel in the form of a fine fog of oil. This oil catches fire immediately and its burning puts more pressure on the pint of air and forces the piston down. We have a power stroke.

Such high compression is not possible in the gasoline engine. Since its fuel is already in the cylinder when the up-stroke begins, it would be set off long before a pressure of sixteen atmospheres could be reached. The piston stroke, up and down, would be shortened and a knock would develop.

To eliminate the carburetor and the spark plug Diesel engineers had to solve a difficult problem—how to get fuel into the cylinder after the air was compressed sixteen times and

was exerting a pressure of 500 pounds to the square inch? At first compressed air was used, but was not entirely satisfactory. Today injection is by mechanical means. Solid injection, it is called. A good unit ejector (solid) hurls the oil into the combustion chamber at pressures of from 3,000 to 20,000 pounds to the square inch. (A mile down in the ocean water pressure is 3,000 pounds to the inch; to reach 20,000 the ocean would have to be nine miles deep.) You might call the unit injector the heart of the Diesel engine. It is in effect a glorified squirt gun, a pump with a nozzle. The nozzle has outlet holes about the diameter of a small needle which discharge into the top of the cylinder.

The fuel pump plunger, or piston, must be fitted to its cylinder walls with extreme accuracy to prevent the oil from leaking past it. It is said that a human hair would have to be split to 1/120th of its diameter to pass between the piston and the pump wall. It is not hard to believe that oil pushed down through the tiny holes of the nozzle is moving at 780 miles an hour when it hits the combustion chamber of a Diesel.

There is but one injector to each cylinder, and the pump is operated by the engine. Its operations are timed closely, coordinated with the cylinder piston stroke, so that the fuel is sure to reach the compressed air at just the right instant.

The amount of fuel is governed by a throttle. Less is required when the engine is running slowly or pulling only a part load. In any event the feed is small for each cycle of the engine. In the streamline train engine the amount of each injection varies from a drop the size of a grain of rice to one the size of an eraser on a pencil—and the cylinders are as big around as dinner plates. Each produces 75 horsepower.

Both strength and accuracy are required of the injector. Actually the injector system is more expensive than the carburetor and sparking system of the gasoline engine.

Simpler Diesels are of the four-cycle type. This means that only one piston stroke out of four is a power stroke. Assume that the piston is at the top and the combustion chamber contracted to its smallest. The first stroke downward sucks in air. The next, upward, compresses that air. Injected fuel burns and the piston beats downward; this is the power stroke. The fourth and last stroke expels the products of combustion.

But Diesel engineers, after years of work, have found ways to make a two-cycle engine work, so that every stroke is either a power or a compression stroke. In the two-cycle the engine cannot be used as its own air pump; it hasn't time for that; air must be forced into the cylinder by a pump.

Roughly speaking, a two-cycle engine produces twice the power of a four-cycle of the same size. And the engines of the streamline trains are all two-cycle.

Next Sunday—Modern ways in which the Diesel proves its worth.

Mostly About Dogs

By BOB BECKER



(Photo by Mrs. L. C. Mudd.) Cocker spaniels, Koko Boy of Burrell and Patch Quilt, owned by Mrs. Albert I. Peterson.

IF DOGS could talk we firmly believe that one of the first things they would say to their owners would be this: "Do not give us frequent doses of worm medicine." It's a dangerous practice and may ruin a young dog.

When we look over the hundreds of letters that come to our desk it is evident that many dog owners consider worm medicines the ideal remedy for just about anything that can happen to their pets. For example, one recent letter described a sick dog. It apparently had distemper—if we are any judge of distemper symptoms. The owner gave the dog a worm capsule and then wondered why the dog grew worse instead of better. To give that sick dog a vermifuge was just like pouring gasoline on a fire! Just about every type of worm medicine contains powerful drugs which are bound to affect the condition of a pet that already is seriously ill.

Another letter from an owner relates the story of a 4½-year-old dog that is having fits. The owner writes that she has been giving the dog worm medicine every month. The fact that the dog has not been throwing fits before this is a tribute to its remarkable constitution, considering the amount of strong, nauseating worm medicine that it has had to take for no good reason.

A typical letter from a dog owner, who has been led to believe that worms are the cause of 90 per cent of dog ailments, follows: "I have a wire-haired terrier a little more than a year old. It hasn't been well for a week."



A champion schipperke, Seeches Picaro.

She shivers, there is a discharge from her nose, and her breathing is not right. Sometimes she coughs. I wormed her with a capsule yesterday, and she isn't any better. On the contrary, she seems worse. Will you please tell me what to do to help this dog?"

If we owned a young dog that had the above symptoms the first thing we would do is to get it to a veterinarian, because we would be worried about just one thing—distemper.

Not one but several drugs are used in vermifuges. All of them are quite safe if given to a dog on the advice of a veterinarian, but some are poisonous if not administered correctly.

It's true that very young dogs do need to be wormed. A mild dose of medicine to accomplish this may be given when the pup is six weeks or so of age. Breeders differ on the times they consider best for worming small puppies. Some give puppies a

Dog May Be Harmed by Worming



When a dog jumps on a person, Carl Spitz, Hollywood trainer, advises grabbing the animal by his front paws and then walking him backward to cure him of this habit.

mild dose of vermifuge around six weeks and another a little later. We know some breeders who do not administer a vermifuge until the ninth week, providing the pups are well. But, once the puppies have been treated and they are free of intestinal parasites, there is no reason to give them additional doses unless an examination proves that such treatment is needed.

For years we have followed this procedure with our dogs. They are taken to a veterinarian from time to time to have their teeth scaled and their ears checked. It's important to keep tartar from forming on the teeth and infections from developing in the ears. This is especially true of some of the sporting breeds like the retrievers which get a lot of water in their ears during the course of the hunting season.

When the dog is in the veterinarian's hands we usually ask him to check the animal for worms. If the dog is in good coat, normal in weight, and generally is in satisfactory condition we are pretty sure that it has no intestinal parasites. But we can make sure by having a veterinarian look over the pet.

DOG NOTES

Many veterinarians believe that short-haired dogs are more susceptible to heartworms than long-haired dogs, because they have less protection against mosquitoes, which carry the disease. However, a recent survey by a southern doctor indicated that the rate of infection was about the same in dogs of the two types of coat.

This department recently received the following letter: "Will you please give me any names and addresses you may have of kennels raising German police dogs (not German shepherds), and whose stock is pedigreed?" The answer to that inquiry is that there is no such dog as the German police dog. The dog commonly misnamed the German police dog is really the German shepherd. They are not different breeds.

American Field has accepted the merry little American water spaniel as an accredited breed and a pure-bred. It now is registering dogs of this breed in its stud book. We know the American water spaniel as an efficient hunting breed. We have had many ducks retrieved for us by one of these spaniels which was owned by one of our hunting partners. American Field says the American water, or brown, spaniel "is distinctively American, perchance even more so

than the Chesapeake. Possessed of extraordinary hunting propensities, courage, stamina, and aquatic abilities of a high order, the breed has enjoyed favor for many years. Over a considerable period some fanciers, steadfast and loyal, have bred the American water spaniel true to type, keeping an accurate record of matings and pedigrees, and this authenticated information provides a basis for the recognition of the breed."

Scout, a collie which posed for a famous statue, died recently at the age of 14½ years. Scout posed for Lorado Taft when he made his statue, "The Pioneers," which stands in Elmwood, Ill. It depicts a pioneer family, their faithful dog beside them.

The Question Box

I have always been fond of the Scotty. Now I am about to choose a dog for a child. Would you recommend the Scotty? I want to make a wise choice. MRS. HARVEY C.

The Scottish terrier is a handy size, easy to keep around the house, not a pig eater, and has an excellent disposition. It isn't as noisy as many of the medium-sized or small breeds. It's a very affectionate breed and extremely faithful. We are sure you would not make a mistake in selecting a Scotty for a child.

● For attractive offers of dogs, turn to the Dogs, Cats, Birds, and Pets columns in the want ad section of today's Tribune.

