Apparatus Innovations in the Past 100 Years

by Battalion Chief John A. Calderone

Engine 18 posed with an early version of the "modified" hose tender. Originally, only the driver rode on the hose tender. Seats were added over the hose reel and a small step was added to provide riding positions for engine company personnel. *all photos by or courtesy of Battalion Chief John A. Calderone*

When the paid Fire Department was established in New York City in 1865, the apparatus best could be described as primitive. Most of the apparatus were former hand-drawn volunteer rigs that were converted into horse-drawn by the new paid Department. Each engine company operated a steamer and two-wheel hose tender, which carried the hose on a reel. Ladder companies operated wagons that carried portable ladders up to 73 feet in length. Aerial ladders had not been invented yet.

Over the years, changes in design of fire apparatus evolved, usually as the result of a Department requirement or response to a problem, sometimes with the introduction of new technology. In tracing the evolution of FDNY apparatus for this article, the 10 most significant innovations that have brought us to our contemporary apparatus will be highlighted.

Riding positions

The first major apparatus design change to take place was providing riding positions on the apparatus for on-duty personnel. This took place in two phases. Since the first year of the paid Department saw 34 paid engine companies and 12 paid ladder companies replace 123 volunteer units, the paid units had larger initial response areas. To keep the number of on-duty personnel to a reasonable number, the new paid Department established its units employing apparatus modified to be pulled by horses. This also required that seated positions be installed for the drivers. Engine and ladder company on-duty strength consisted of 12 men per unit.

Initially, Department regulations stated that a maximum of only three men were permitted to ride on steamers, two on hose tenders and just the driver and tillerman on ladder trucks. Everyone else--including chief officers--ran alongside the apparatus when responding to alarms. This situation seems to have been a holdover from the traditions of the volunteer department. None of the volunteer apparatus was horse-drawn and everyone was needed to pull the apparatus; hence, there were no riding positions on the apparatus turned over by the volunteers. When the apparatus were converted to horse-drawn, there was no prior reason to have riding positions added because the men never rode the apparatus before.

Because the new paid firefighters were responding to more alarms than the volunteers ever did and because they were arriving at the scene of these alarms physically exhausted, the new paid Department set out to devise a method for the firefighters to ride to fires rather than run. After some trial and error, the Department came up with the concept of placing firefighters on long steps mounted on the side of the ladder trucks. These wood boards--designed to replace the practice of running to fires alongside the apparatus--became known as "running boards." Solving the problem for ladder trucks, attention was turned to the engine companies. There was no practical way to place additional men on the steamers. An "improved" hose tender was designed by placing seats topside above the hose reel and adding a back step that could accommodate up to three firefighters. This rear step eliminated the fuel box and required establishing separate fuel wagons to carry a supply of coal and wood to keep the steamers in operation at fires.

The earliest apparatus used by the Department had minimal riding positions. Although Ladder 1's entire on-duty crew of 12 posed on their apparatus in front of City Hall for this photo, only the driver and tillerman actually rode on the apparatus to fires. There are no other riding positions or running boards on this apparatus. The remaining members ran alongside the apparatus, the origination of the term "run," when referring to a response.

For a time, chief officers continued to run to fires. Gradually, starting in the outlying areas, because their response districts were larger, chiefs were assigned horses to ride to fires. Eventually, horseback riding gave way to a small, horse-drawn buggy.

Development of the aerial ladder

The first aerial ladders began to be introduced into the fire service during the 1860s. However, acceptance of this equipment in New York was delayed because of a fatal accident in 1875. The Department had arranged to purchase four 97-foot wood aerial ladders. During a public demonstration, one of the aerial ladders collapsed, killing three firefighters. Subsequently, it was determined that political payoffs had been involved in the purchase of these apparatus and that they were constructed of inferior quality materials and workmanship. However, the damage had been done and, as a result, New York kept its distance from aerial ladders until 1879.

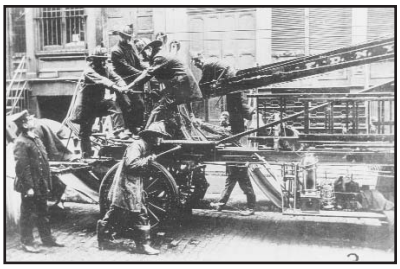
During that year, a Hayes aerial ladder was loaned to the Department for a trial period. It was a two-section, 80-foot wood ladder with the tiller seat located beneath the aerial ladder. The aerial was raised manually by a worm screw turned by a handle extending forward of the turntable. Extension of the upper section was accomplished manually via a cable and winch. Several men were required to manually raise the ladder, but the aerial was much more efficient and safer than using long portable ladders. Unfortunately, New York did not purchase this apparatus.

However, the Brooklyn Fire Department, a separate Department until 1898, recognized the advantages of this apparatus. In 1883, Brooklyn purchased this aerial ladder and quickly embarked on a program of replacing most of their older ladder trucks with aerial ladders, adopting the Hayes aerial as standard equipment for its ladder companies. Prior to the development of the aerial, numerous men were required for ladder companies to raise and position long portable ladders. The aerial ladder eliminated the need to carry the longest portable ladders and allowed for a shorter, more maneuverable ladder truck design. New York still was slow to purchase aerials but, starting in 1886, New York began replacing its ladder trucks with aerial ladders.

Motorization

The next major change in apparatus design probably was the most significant. Just after the turn of the century, the internal combustion engine started to become popular and automobiles began to appear on city streets. The first motorized vehicles to be purchased were two American Mercedes touring cars, acquired for the Commissioner and Chief of Department in 1904. It took a few more years before the Department considered the automobile reliable enough to purchase a motorized firefighting vehicle, but in 1909, a Knox high-pressure hose wagon was delivered. By 1911, a plan was proposed to motorize the entire Department.

The most pronounced benefit of motorized apparatus was their greater operational range when compared to horse-drawn apparatus. This eventually allowed for fewer fire companies. A horse-drawn steamer carrying three men weighed about 10,000 pounds, while a horse-drawn, 75-foot aerial carrying eight men weighed about 12,000 pounds. Pulling this weight, even the best horses began to slow down after about a half mile at top speed. Response time to multiple alarms was extremely slow for horse-drawn apparatus.



Almost the entire ladder company crew was needed to manually get an early aerial ladder raised and into position, as shown here by members of Ladder 20.

The anticipated annual cost to operate a motorized tractor was $414.60 for gasoline, oil, maintenance and depreciation (based on a 20-year service life), while a three-horse team cost $900 annually for feed, veterinary services, shoeing, stable equipment and harnesses. Annual fuel costs were narrowed to $85 per year per rig for gasoline versus $660 for feed for every three horses, the average number of horses per unit. Each

The Department's first motorized firefighting vehicle entered service at Engine 72, then located in lower Manhattan, on February 6, 1909. The apparatus was a high-pressure hose wagon built by Knox.

As the size of both motors and pumps was reduced, it became possible to add a hose bed to pumpers. Engine 205, shown here at a symbolic "last horse-drawn run" is replacing both its horse-drawn steamer and hose wagon with a single motorized pumper. Engine 205 was the last unit to be regularly assigned horse-drawn apparatus, which were replaced in 1922 by an American LaFrance pumper.

motorized engine company showed financial savings of $817.26 annually. (Keep in mind that these amounts were considerable sums in 1911 dollars.)

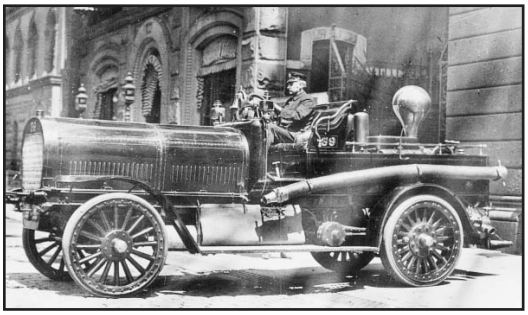
The Chief of Department proposed a program to motorize the entire Department by 1917, although complete motorization did not occur until 1925. All new apparatus purchased were motorized. However, the Department owned a large amount of relatively new horse-drawn equipment, especially steamers and aerials, which still had plenty of years of service left in them. This problem was resolved by the large-scale purchase of two-wheel tractors, which were mounted under the horse-drawn equipment. By the time motorization was completed, the cost of operating a horse-drawn unit had grown to five times greater than operating a motorized unit.

Triple-combination pumper

Concurrent with motorization was the development of a motorized pumper to replace the steamer. The last steamers were delivered during 1912 and 1913. These had been ordered with tractors. The triple-combination pumper evolved over an extended period of time. The first motorized pumpers appeared in New York in 1911. They were just that--motorized vehicles that carried a pump that could be powered by the vehicle's power plant.

Both the pumps and motors of early pumpers were quite large. There was little room for hose or equipment and these still were carried by separate hose wagons. As refinements were made to both motors and pumps and their size decreased, it became possible to include a hose bed on the pumper, eventually eliminating the need for a separate hose wagon. The development of the booster tank with its accompanying hose reel gave the pumper/hose wagon combination a third function and greatly increased its effectiveness.

Although there were several earlier makeshift experiments and booster equipment had been used much earlier in other fire departments, New York's first booster-equipped pumpers entered service in 1946. These apparatus were extremely effective in the outlying areas of the city where water mains and hydrants had not been installed yet. The booster tank allowed an engine company to operate for a period of time without being hooked up to and supplied by a hydrant. Prior to the inclusion of booster tanks on pumpers, engine companies had to hook up to a hydrant and stretch a line at every operation, regardless of how small the fire. Certain operations, such as car fires on bridges or highways, were major operations without booster tanks. The booster tank gave the apparatus more options for positioning, especially at non-structural fires, and also increased the efficiency of the pumper.



FDNY's first motorized pumper was this 1911 Waterous 750-gpm unit assigned to Engine 39. While the motor took up a good portion of the apparatus, the pump took up the remainder and is positioned behind the seat. There was no space on the pumper to carry hose and separate hose wagons were required.

Metal aerial ladders

Metal aerial ladders were developed prior to World War II, but their widespread introduction into the fire service was delayed because resources were allocated to wartime production. New York purchased its first metal aerial ladders in 1948. The metal aerial ladder design allowed for an apparatus that was, on average, 10 feet shorter than wood aerial ladders. Additionally, with the hydraulic systems of metal aerials, one firefighter could raise, rotate and extend the aerial. To do this with a wood aerial required the commitment of the entire unit. The metal aerial freed up the rest of the unit's personnel to commence forcible entry, search, ventilation and placement of portable ladders. These functions were delayed when the use of a wood aerial initially was required.

Another design change ultimately resulting from the metal aerial ladder was a permanently fixed tiller seat, windshield and steering wheel. On older wood aerials, these were positioned above the aerial. It was necessary to fold the windshield and tiller seat out of the way, disconnect the steering wheel and remove the steering shaft to raise the aerial or remove portable ladders from the ladder bed beneath the aerial. The shorter overall length of metal aerials, when bedded, allowed for the design of a permanent tiller position, providing more efficient design and use of the apparatus.

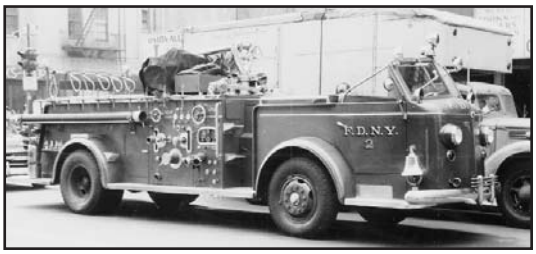
The metal aerial ladders also were equipped with ladder pipes; some permanently installed, others portable. Ladder pipes permitted the application of elevated large-caliber streams. Installed on regular ladder company apparatus, this equipment eliminated the need for separate special units known as water towers, whose only function was the application of elevated large-caliber streams.

Cab-forward apparatus

The earliest cab-forward apparatus on FDNY's roster were delivered in 1947. Up to that time, the vast majority of apparatus were of the conventional, engine-forward design--with long noses--and the driver positioned quite a few feet behind the front bumper. When approaching a congested intersection, sometimes it was necessary to place a few feet of the apparatus out into traffic before the driver could see the oncoming traffic. The cab-forward design was much more suited to urban driving conditions and added to firefighter safety. It provided the driver with far greater intersection visibility than conventional cab designs and allowed him to obtain a much better perspective. It was more maneuverable, with a much shorter turning radius and more easily positioned. The idea caught on slowly in New York, but by the late 1950s and through the present, most apparatus purchased have been of the cab-forward design.

Radios

The first Department two-way radio system was placed into service during 1936. Originally, only the fireboats had radios. The Rescue Companies and staff chiefs' cars quickly followed. The system was very limited, with only a 25-mile range from its Central Park antenna. By the end of 1952, every apparatus was equipped with a two-way radio.



The earliest cab-forward design apparatus to enter service in New York City were a group of 20 1947 American LaFrance pumpers. This design proved more suitable to urban operations and virtually every apparatus in FDNY's fleet today is of this design.

It is hard today to imagine how the Department func-

Mack Trucks developed the first tower-ladder in 1964, in conjunction with FDNY, to meet specific design and operational criteria common to New York City. The tower-ladder revolutionized firefighting procedures in New York.

tioned without an apparatus radio system. Prior to radios, when an alarm was transmitted, every unit assigned had to respond all the way to the reported location. There was no way to turn around units that were not needed. If the first unit to arrive determined that the alarm was false, they had to wait at the scene until every unit assigned to the alarm arrived at the scene, to advise them of the disposition. Then, the units had to respond back to quarters to return to service quickly.

Before radios, once an apparatus left quarters, it was out of contact with the dispatcher until it returned to quarters. There was no way to redirect units to another location, give responding units additional information, return to service those units not needed or any number of functions that we take for granted today. Also, there were no outside activities of any kind. The apparatus left quarters only in response to an alarm.

Apparatus radios gave the Department a tremendous degree of operational flexibility that it never had before. Radios allowed for the implementation of apparatus field inspections, hydrant inspections, outside drills and other activities. Radios also added greatly to operational efficiency, permitting redeployment of responding units, relaying orders and instructions for incoming units and stopping the practice of responding back to quarters following alarms, an added safety bonus. Because of radios, the Department was able to eliminate most second sections, as well as some closely spaced units and redeploy most of their manpower to establish new units in developing areas.

Tower-ladders

During the early 1960s, most major fire apparatus manufacturers were introducing their own versions of elevating platforms. New York was somewhat unique in terms of building construction, street layout, street congestion and overhead obstructions--such as elevated train structures--when compared to most other major cities. Each of the aerial platforms then available had some major drawbacks when considered for operations in New York's conditions. Working with Mack Trucks, an apparatus was developed that was very specific and tailored to New York City's needs.

The original tower-ladder was only slightly longer than 35 feet, perfect for responding and positioning in New York's street conditions and much shorter than today's towers. The first tower-ladder was delivered in 1964 and assigned to Ladder 1. This apparatus responded to virtually every major fire throughout the city, not only proving its value, but also establishing new tactics and procedures with its new capabilities. A second tower-ladder was placed into service at Ladder 14 in 1966. Based on the high degree of operational efficiency shown by these two tower-ladders, plans were drawn to purchase more of these units.

Originally, there were plans to place 10 tower-ladders in strategically selected ladder companies throughout the city, keeping an additional one as a spare. However, as these units proved their worth at fire after fire, more and more were purchased until eventually, approximately 40 percent of the Department's ladder companies were equipped with tower-ladders.

Following widespread civil unrest, the Department sought to provide a higher degree of protection to firefighters than was offered by open-cab apparatus. The first attempt at a crew cab design was a modified highway maintenance truck design. These apparatus proved less than desirable and the cab-forward model was redesigned into a crew cab.

These apparatus revolutionized firefighting tactics, particularly at the often-common, fully involved vacant building fires then regularly encountered. Often, several strategically positioned tower-ladders negated the transmission of additional alarms and simultaneously provided a far greater degree of safety than using traditional tactics. Tower-ladders were able to deliver a large-capacity stream with pinpoint accuracy. There is no doubt that the Department would have had far greater difficulty in dealing with the heavy fire duty of the "war years" without tower-ladders.

Modern power

All contemporary FDNY fire apparatus are diesel-powered with automatic transmissions. In fact, few firefighters today ever have driven a heavy-duty vehicle with a standard transmission that was not syncromesh and needed to be double-clutched. However, at one time, every apparatus was so equipped and was gasoline-powered.

Driving these vehicles while responding was an art that required a great deal of skill and attentiveness, constantly upshifting away from intersections and downshifting approaching intersections. Additionally, all apparatus had manual steering. The first automatic transmission was introduced as a pilot program on a 1958 Mack pumper. This apparatus was reassigned to several different units for evaluation.

The first diesel-powered apparatus also was introduced as a pilot program, on a 1962 Mack pumper. Diesel-powered apparatus were more powerful, required less maintenance and were more fuel-efficient than gasoline-powered apparatus. These two pilot programs came together with the delivery of 10 Mack pumpers in 1965. Starting with those apparatus, diesel power and automatic transmissions became standard equipment for FDNY pumpers. It took a few more years for these to become standard on ladder apparatus. These two innovations provided more powerful vehicles that were easier to drive and greatly increased the potential chauffeur pool.

A few years later, power steering was added as standard. Those chauffeurs who drove apparatus that were not equipped with power steering remember well their sore arm muscles following a busy tour during the "war years."

Enclosed apparatus design

The design of contemporary apparatus has evolved very slowly over the years. However, sometimes events occurred that prompted major changes in a short period of time. The civil unrest of the 1960s was one of those events and the major catalyst in today's apparatus designs.

Open-cab apparatus with running boards and back steps were common then. Firefighters and fire apparatus became targets of the rioters. An increasing number of incidents involving missiles thrown at apparatus and members being injured convinced the Department to retrofit existing apparatus with plywood enclosures over the cabs, back steps and tiller seats. Simultaneously, the Department began working with apparatus manufacturers to get everyone inside, in a protected position.

Another problem of that time was stolen tools and equipment. At the time, all equipment was carried in an exposed position, available for immediate use by firefighters. When equipment started to disappear at the scene of operations--and worse--sometimes used as weapons against firefighters, it became necessary to secure everything carried on the apparatus.

Apparatus design changed relatively overnight, with new apparatus calling for fully enclosed cabs with compartmented bodies. The earliest attempt at this design led to a less than efficient return to a conventional design, basically designing a pumper on a highway maintenance-style chassis with four-door crew cab. This proved unsatisfactory and the cab-forward model was redesigned into a four-door version. This design has been refined since, resulting in today's air-conditioned vehicles with everyone riding in a seated, belted position. Better warning lights, reflective stripes and the two-tone color scheme are all part of this design evolution.

An unintended advantage of the crew cab has been a reduction in injuries while responding. At one time, falls from moving apparatus averaged one per month. Most of these resulted in serious injury and many firefighters died as a result. Today, such injuries are almost nonexistent.

One can trace the evolution of fire apparatus design by comparing photos and data of apparatus purchased year by year. Little subtle changes occur almost every time an order is placed. Sometimes these are minor refinements; other times, they are major departures. This will always continue in order to keep pace with changing technology and meet operational requirements.

About the Author...

Battalion Chief John A. Calderone is a 25-year veteran of the FDNY. Currently, he is assigned to Battalion 22. He holds a degree in Fire Protection from New York City Community College and has written extensively on the subject of fire apparatus. He is a regular contributor to WNYF.