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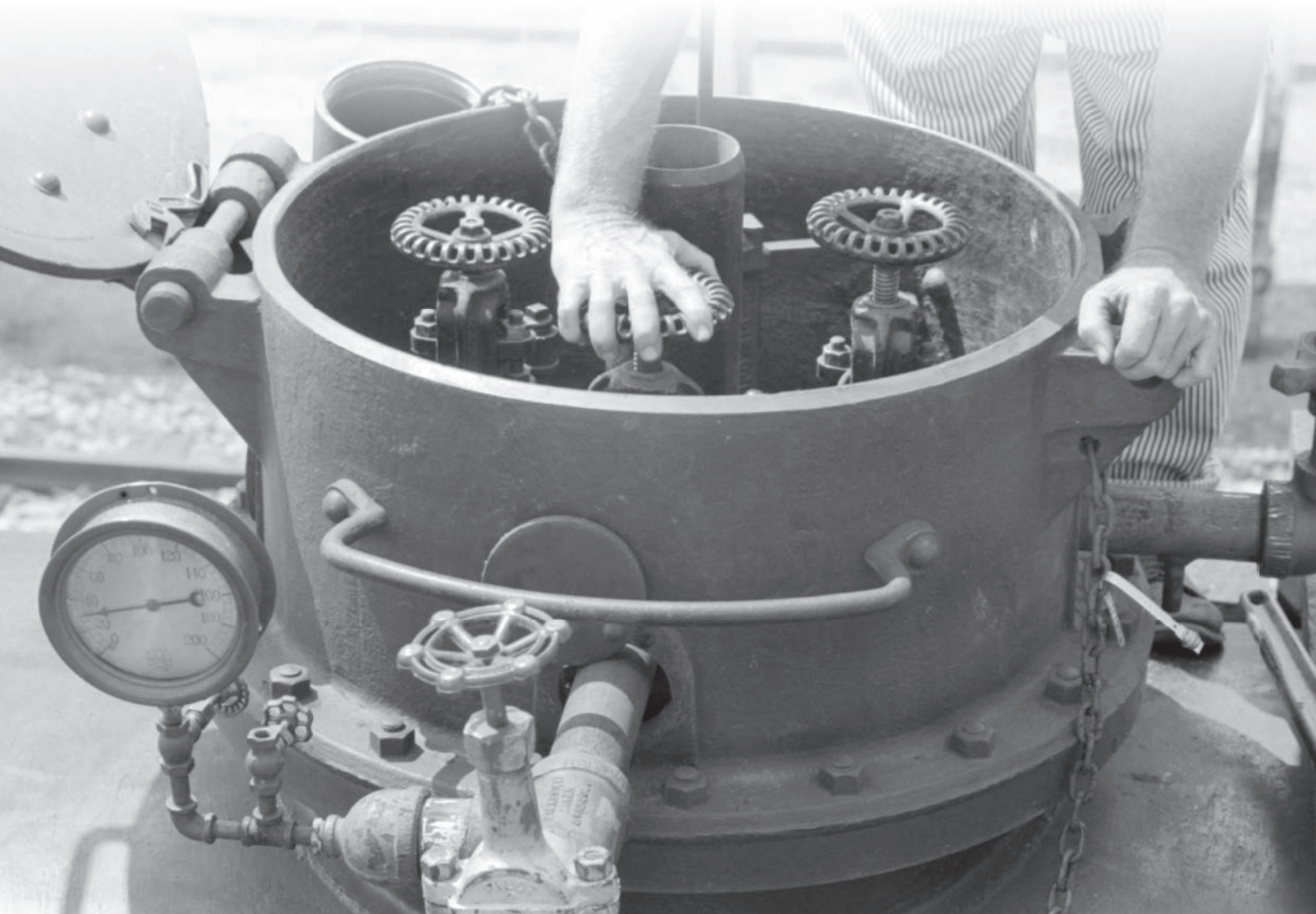
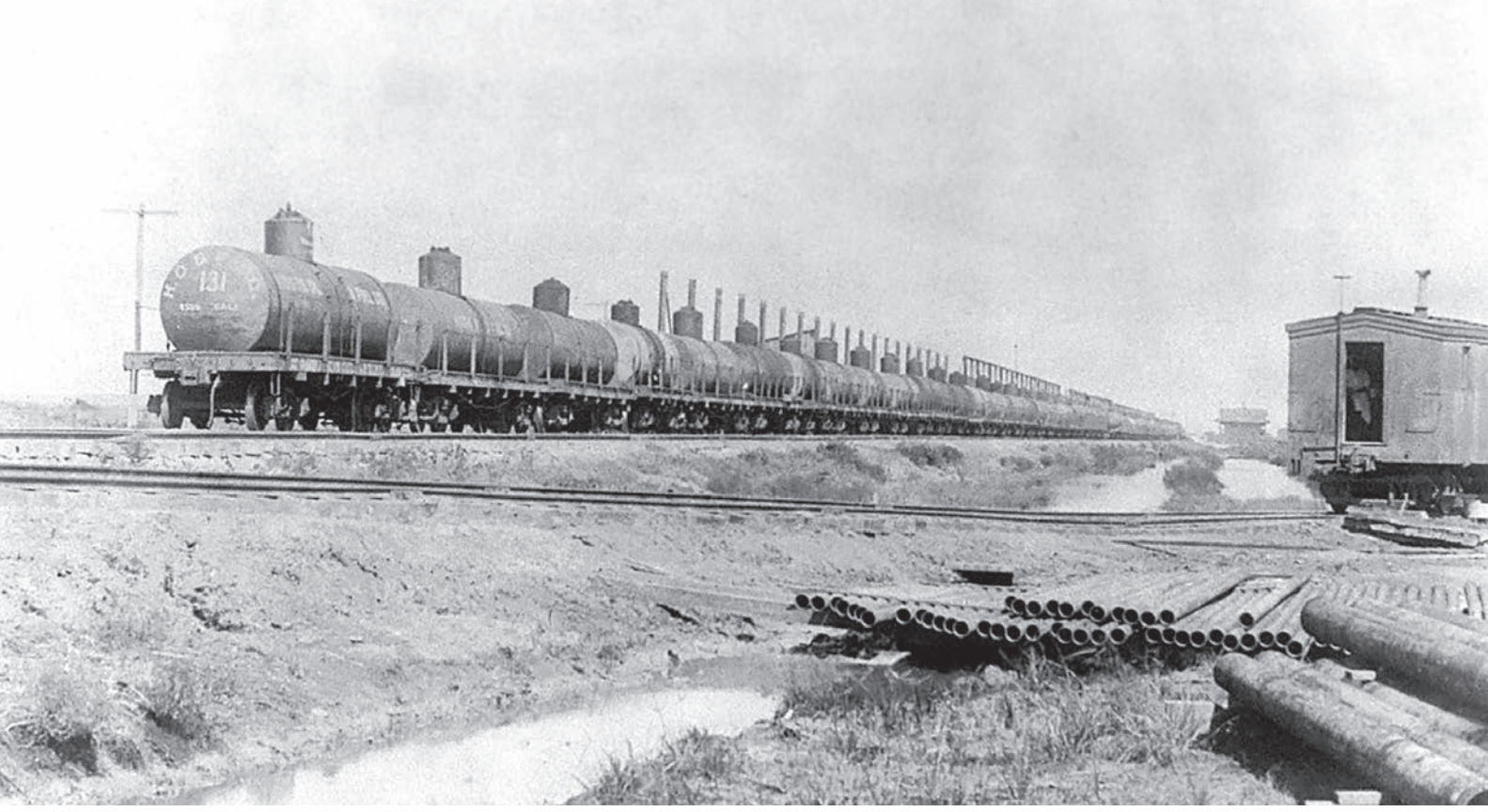




CHAPTER ONE

History and oil field operations

A long string of tank cars awaits loading with crude oil at Spindletop, Texas, in 1901. The huge oil strike near Beaumont, Texas, led to the Gulf Coast region becoming a center of refining operations for the next century.
Library of Congress

The discovery of oil in Pennsylvania in 1859 was a momentous occasion, although few realized it at the time, calling Edwin Drake's well "Drake's Folly." Indeed, it took time to figure out what to do with all of the crude oil, and no one was sure whether the supply would last. Over the following decades the American oil industry boomed, thanks to growing population and the emergence of the gasoline-powered automobile. Oil companies became key customers for railroads, with tens of thousands of tank cars carrying millions of gallons of crude oil and finished products.

A unit train of crude oil in new Trinity-built tank cars rolls through New Castle, Del., on Norfolk Southern in 2013.
Michael S. Murray

Although long-distance pipelines and trucks began taking much of this business away from railroads by the 1950s, railroads still carry a significant amount of petroleum traffic. New oil fields and improved extraction technologies have led to an increase in crude oil traffic by rail, and railroads still haul some gasoline and other products as well as significant carloads of liquified petroleum gas (LPG).

The history of the oil industry could take up many volumes, and there are indeed hundreds of books and online sources that do that. So our summary will, of necessity, hit just the highlights. In this chapter we'll start with a brief look at the history of the petroleum industry, see how companies get oil from the ground, and examine how railroads became part of the process.

Early history

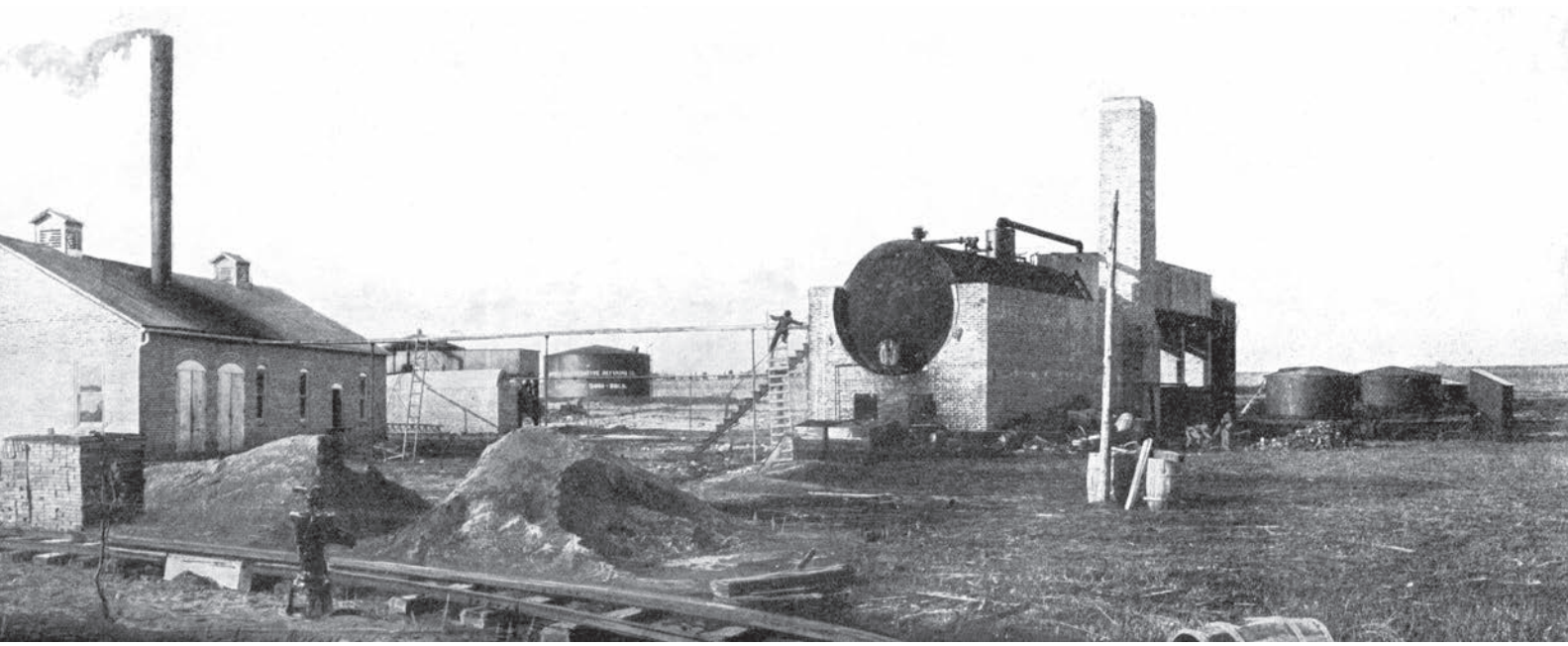
People were aware of oil and gas buried in the ground long before Drake began drilling. Some cultures have been using oil for thousands of years, but on a small, local level. Capturing oil, then processing and delivering it on a large scale, was something different.

The first refinery appeared in Pittsburgh in 1853, six years before Drake's well. The refinery was built by Samuel Kier, who was looking for a use for the oil that had been fouling his salt wells. Kier's experiments produced light oil from the crude, which he marketed for use in lamps. Colonel A.C. Ferris, who improved upon Kier's methods, is credited with the 1857 discovery that kerosene could be distilled from crude oil.

This kerosene found a ready market for use in lamps and lanterns, as it produced better light with less smoke than coal oil. Both were looked at as alternatives for whale oil, which at the time was regarded as the best fuel for lamps and lanterns. However, as population grew and demands for whale oil increased, it was becoming harder to get and more expensive.

Edwin Drake's company in 1859 began drilling a well near Titusville, Pa., an area where oil sometimes oozed out of the ground on its own (to the annoyance of farmers and local residents). Drake took advantage of a then-new technique of using a stationary steam engine to drive a pipe into the ground to tap the oil, as opposed to digging a pit or shaft. The going was slow—about three feet per day—but Drake struck an oil deposit at 69 feet. The oil began coming out of the pipe, eventually at the rate of about 20 barrels per day (the 42-gallon barrel remains the industry standard for measurement; the abbreviation for barrel is "bbl").

Drake's success would lead to other wells in the region, providing a ready supply of oil for refiners. The challenge then became how to process it efficiently. The first (and only) goal of early crude production was getting the kerosene out, which was not an easy task.



The batch-process still (center right) at this circa-1907 refinery has a 600-barrel capacity. At left is the boiler/pump house; in the distance between them is a 5,000-barrel crude oil storage tank. The refinery was in Chanute, Kan. *Library of Congress*

Typical of small refineries of the period, this Barnsdall refinery in Wichita, Kan., processed 5,000 barrels per day in the early 1940s. A fractionating tower stands just to the left of the tall sign. *Marion Post Wolcott, Library of Congress*

Sulfur content (or lack thereof) is also important: Crude oil high in sulfur is termed "sour" while low-sulfur oils are "sweet."

These varying properties result in higher and lower yields of specific final products (more or less gasoline or lubricating oil, for example), and refineries often blend crude of different properties before processing it. Crude also varies widely in viscosity and in appearance, from nearly clear to brown, red, or black.

Chemically speaking, crude oil is about 84% carbon, 14% hydrogen, and 1% to 3% sulfur, with traces of other elements. Salts and trace metals must be removed before or during processing.

Crude comprises a mix of hydrocarbon molecules, each of which includes one or more atoms of each (hydrogen and carbon). The refining process breaks those molecules down and separates them, grouping them into separate products called fractions. The fewer the carbon atoms in the molecule, the lighter the fraction: for example, gases have one to four carbon atoms; liquids, five to 70; and solids, 70 or more. For example, propane (C_3H_8) has three carbon atoms and eight hydrogen atoms and is a gas at normal atmospheric pressure.

The first primitive refining processes of the 1860s focused on kerosene; later came gasoline and lubricating oils, and by the early 1900s, various refinery processes allowed virtually all of the crude oil to be processed.

Each gas, liquid, or solid fraction has unique properties and various end-product uses. The chart on page 23 lists the common fractions, along with their carbon counts from lightest to heaviest, and includes some typical uses. The lighter the fraction, the more volatile (the more quickly it will evaporate).

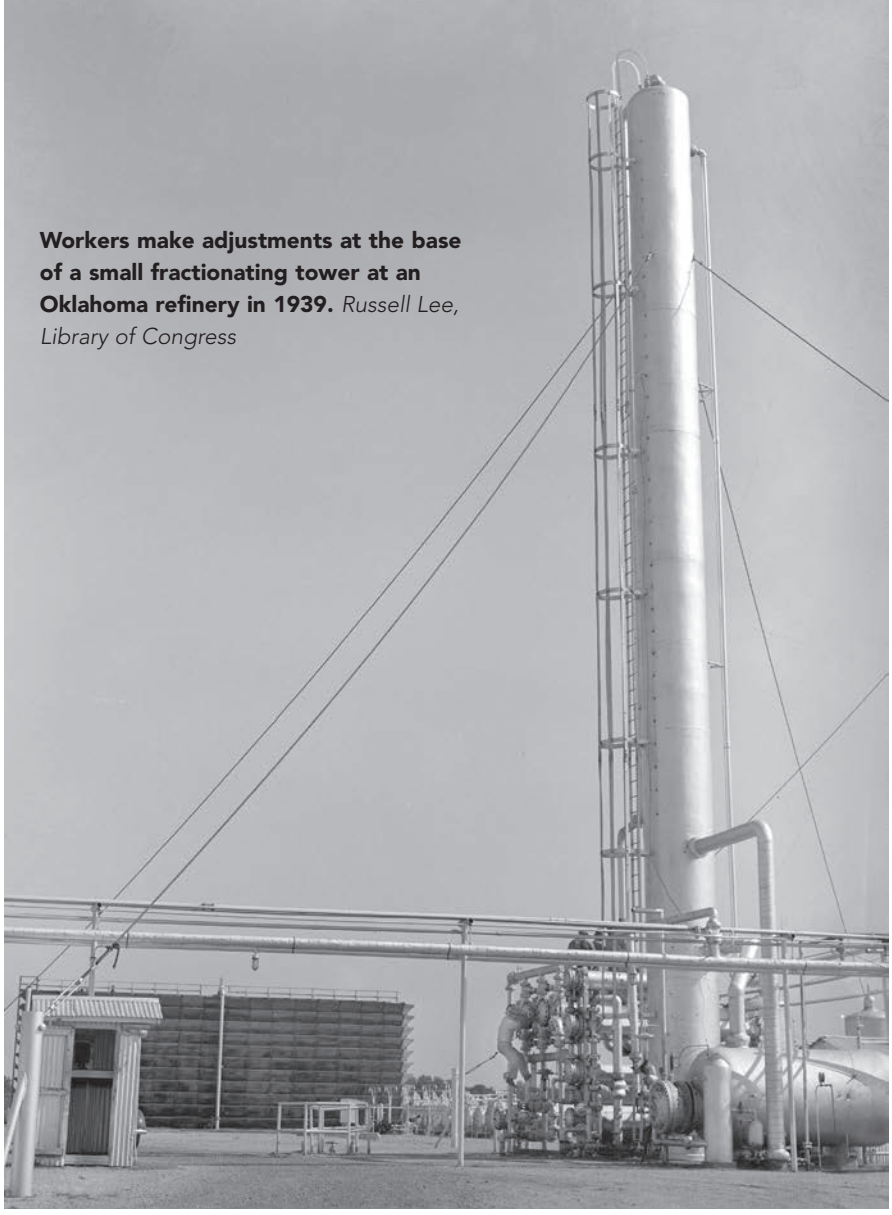
Early refineries

Refining is the process of distilling crude to capture its fractions. The descriptions that follow cover refineries in general, but no two refineries are exactly the same. Most are designed to capture as much gasoline as possible, but other refineries are designed to specialize in other products, such as lubricating oil.

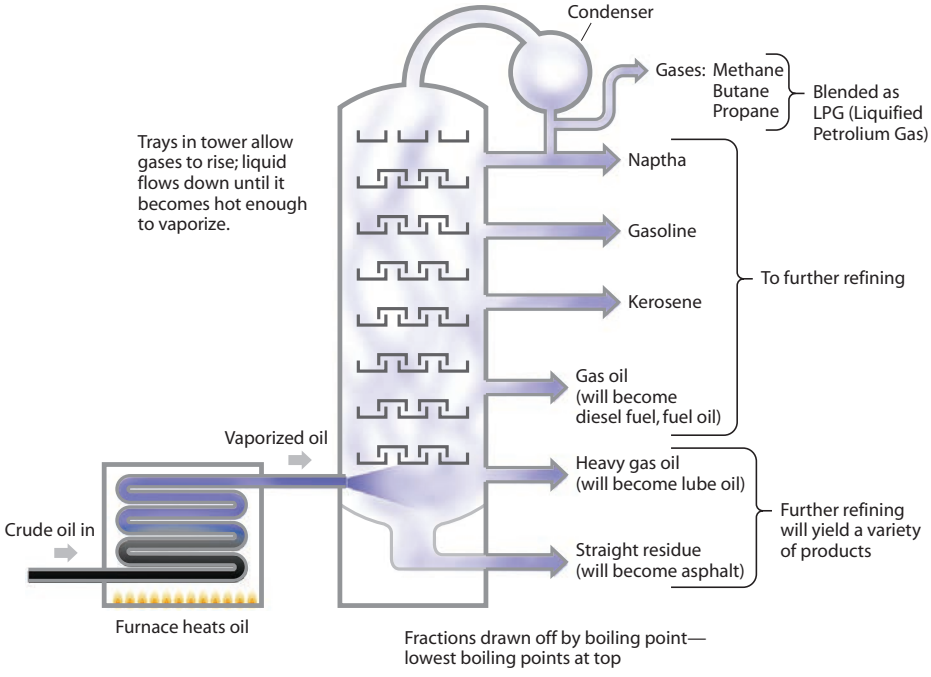
The most basic way to refine crude oil is by applying heat. As the temperature of the oil rises, the lightest fractions rise to the surface and evaporate or are captured. The first refineries of the early 1860s were simple stills that heated kettles of crude oil over an open fire (known as "atmospheric distillation"). The gas fractions were simply allowed to evaporate, while the next fractions—naphtha, gasoline, and kerosene—were literally skimmed off the top. At the time, kerosene was the most desired fraction, in demand for use in lamps and lighting. Most other products, including gasoline, were considered waste products and were burned off or otherwise discarded.

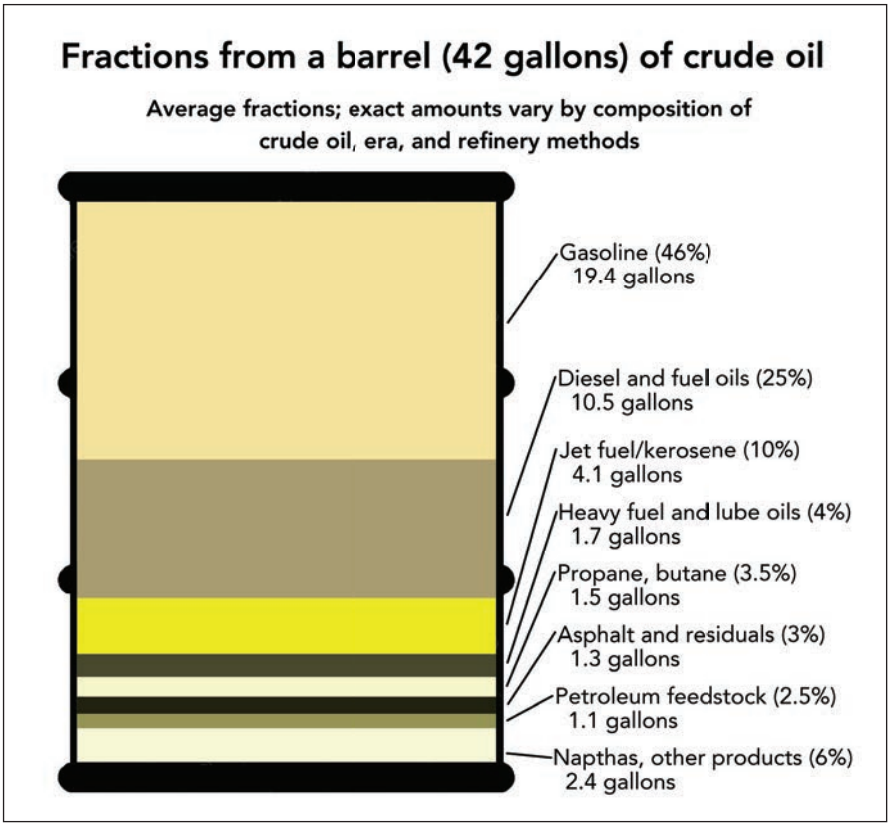
As you can imagine, this method was inefficient, slow, messy, and above all, dangerous. Fires and explosions were common. As demand for kerosene and other products increased, safer and more efficient distillation methods were needed.

The first step was to cover the container being heated, with a coiled copper condensing pipe at the top. This allowed collecting the fractions as they gassed off, then directing them downward and away from the heat



Workers make adjustments at the base of a small fractionating tower at an Oklahoma refinery in 1939. *Russell Lee, Library of Congress*





Several tank cars rest on the cleaning track at the Humble refinery in Baytown, Texas, in December 1944. The tall structure is a catalytic cracker. Steam is rising from the cleaning hoses in the tank cars. As the runoff on the ground shows, the environment was not a priority for early refineries.
Standard Oil Co.

CHAPTER SIX

LPG tank cars

Manufactured in 1927 by American Car & Foundry, this Phillips car is one of the first LPG cars built. The 11,000-gallon car was still in service in this 1966 image. It's an ICC 105A100 car, with a forge-welded tank. The white streaks are from oxidation of the lettering. *Jeff Wilson collection*

The late-1920s growth of propane and butane (collectively known as liquefied petroleum gas, or LPG) as popular home-heating fuels, especially for customers in rural areas, required development of high-pressure welded tank cars. It's a traffic source that has expanded to many industries and continues for railroads today, with larger, modernized tank cars.

General American built this 11,000-gallon pressure car in 1955. The ICC 105A 300W car is carrying LPG for Union Texas Natural Gas Corp., a division of Allied Chemical. *J. David Ingles*

Although propane and butane are gases at normal atmospheric pressure, they're easily compressed to liquids at room temperature at fairly low pressures (around 100 psi). This makes LPG practical to store and transport in liquid form, and since LPG is difficult to ship by pipeline, railroads remain a key shipper of the product.

Along with fuel, LPG has found a number of other industrial uses, including as a propellent and as a feedstock (raw material) in the petrochemical industry to make a variety of other products, including plastics, rubber, and pharmaceuticals.

As Chapter 2 explains, the LPG market began growing quickly in the early 1930s, when Phillips began marketing it as a clean-burning home heating fuel (calling its version Philgas). Other companies soon followed; Skelly Oil called its product Skelgas, Pure Oil Co. had Puregas, and generic names included "bottle gas" or "home gas." Soon LPG was being sold by many refining companies across the country, especially in colder climates. Sales of LPG went from 4 million gallons in 1928 to more than 220 million gallons per year by the late 1930s.

As Chapter 3 highlighted, many local LPG dealers also did installation and maintenance on gas furnaces and kitchen appliances, including selling branded appliances, which helped assure the oil companies a growing base of loyal customers for their LPG sales.

Early LPG cars

The initial challenge was efficiently getting LPG from refineries to local dealers. The first rail transport of liquid propane was in 1927, using individual storage containers loaded aboard a flatcar. This proved cumbersome, and tank cars would soon follow.

Tank cars carrying LPG differ considerably from the general-purpose, non-pressure cars used for liquid petroleum products. Pressure cars for LPG have welded instead of riveted seams, with thicker steel shells than non-pressure cars to withstand the forces of the compressed gas. The

Streamlining was coming to fuel truck bodies by the late 1930s. This Standard tank, on a tandem-axle GMC chassis, has side sheathing and distinctive stand-alone side lettering. The dealer is leading a scrap rubber drive near Detroit in 1942, with temporary lettering on the cab and tank sides. *Arthur S. Siegel, Library of Congress*

This Ruan trailer typifies large delivery trailers from the late 1950s through the 1960s, with broad, rounded nose (to allow clearance to a close-coupled cab), side-mounted hose and control connections, and simple, curved mud guard over the wheels. This truck is making a delivery to a Standard station in Iowa in 1957. *Ken Scarpino; Mont Switzer collection*

1,600-gallon tanks by the 1960s, and 2,100-gallon tanks by the 1980s. The body style also continued evolving, with the shrouding continuing farther upward and the tank body itself getting taller (when looking at photos, compare the tank height to the cab roof). The individual compartment capacities are usually stenciled on the rub rails at top of the sides.

By the 1990s, many bodies with tandem axles were approaching 3,000 gallons, and the body style had evolved to again eliminate shrouding.

Most straight trucks (which are still often known as "tank wagons") are in delivery service, owned by fuel dealers and local jobbers, or by local drivers who are contracted to haul for the jobber. Most are not ornately adorned and were typically simple, with painted wheels and grills instead of chrome, and lacking the fancy details found on many owner-operator big rigs.

They are typically painted in the scheme of the oil company they serve, with logos, and may carry additional lettering indicating the local fuel dealer name (with city and phone number, of course). Don't forget warning signs and labels ("This vehicle stops at all railroad crossings," "Inflammable").

As trucks (conventional and tractor-trailers) evolved, their features varied based on whether their purpose was delivery (multiple stops at gas stations, homes, and other customers) or transport (getting as much fuel as possible from one point to another).

Tractor-trailers

Tank tractor-trailers since the 1930s have been most commonly used for

longer hauls from refineries and tank terminals, but have also been used by some high-volume local dealers for local delivery service.

Early semis could be found with single- and twin-axle trailers, but by the late 1950s two-axle trailers became the standard to maximize the payload. Sizes ranged from 3,000 on early trailers to 6,000 gallons by the 1960s; modern trailers are typically around 9,500 gallons, but can be larger depending on state weight regulations. As with straight trucks, tank trailers have multiple compartments, with three, four, or five being common.

Tank trailers carrying fuel typically have elliptical cross sections. The top has skid rails surrounding the domes, designed both to contain any spills as well as to protect the domes, hatch covers, and top of the tank in a rollover accident.

Through the 1960s, most fuel tank trailers were steel. The front end was rounded broadly, providing turning clearance when the kingpin was positioned deep, allowing the front of the tank to be very close to the rear of the cab (see the Ruan truck on the previous page). This minimized the overall tractor-trailer length for clearance. The front often had protruding or recessed steps for roof access.

Early trailers had shrouding around the rear wheels and rear of the tank, much like straight trucks. The delivery hose, control valves, and meter were behind a door on the rear, or in a

Shelby Petroleum in Greenfield, Ind., operated this delivery truck with a Ford C cabover chassis in the 1980s. The modern-style tank lacks the side platforms of earlier tanks, since modern loading racks allow direct roof access. *Mont Switzer collection*

The back compartment houses meters, pumps, and control equipment. The flip-up rear door provides protection to the equipment and operator in bad weather. *Mont Switzer collection*

Weight regulations regarding length in some states resulted in semi tractors with extended frames, such as this 1950s-era truck. Modeling features like this can greatly increase realism by matching prototype practice in specific states, regions, and eras. *Jeff Wilson collection*

To maximize payload while complying with length/weight restrictions, a common setup for transport trucks in California was a large tandem-axle straight truck pulling a trailer. This Shell tank rides on a Peterbilt chassis in the 1970s. *Jeff Wilson collection*

This modern Switzer Tank Lines semi is set up as a portable station to provide fuel for races. It's at Elkhart Lake, Wis., in 2023. Note the side reflective striping, side-mounted delivery connections, top rub rails, and flatter nose compared to earlier trailers. *Mont Switzer collection*

closed belly box below the tank on one side. Designs became more open by the 1960s.

By the 1970s, the trend was toward aluminum tanks, which were lighter and, with revised weight and clearance laws, larger. Trailer fronts were no longer broadly rounded, but slightly convex, with conventional kingpin placement. Gone was the access door at the rear, replaced by the tank end and bumper. Hose connections, valves, and metering are under the tank at the side, usually in the open. Long tubes along the lower sides of the tank hold the delivery hose. A roof access ladder typically runs up the middle of the back.

Older trucks with steel tanks were painted in company colors. Aluminum tanks are often left natural and polished, with the brand name and/or local dealer or jobber name displayed prominently, usually using decals.

Tractors in fuel service were typically designed for short hauls compared to over-the-road van operations, so they usually lack sleeper units. They also often lack the ornamentation of many long-haul tractors. Conventional and cabover tractors were both used, but as with other trucks, the move was to conventional tractors by the 1990s.

In California and some other states, regulations on truck length and bridge weight loading created some interesting vehicle variations. Many tractors had extra-long frames, with a large gap between the rear of the cab and the nose of the trailer. Another common Western variation to avoid that gap and make more efficient use of length was a three-axle straight truck with tank pulling a two- or three-axle tank trailer (single axle in front, one or two axles in rear), with the trailer short enough to match length restrictions. These trailers used a pintle hook connection to the truck instead of a typical semi's fifth-wheel connection.

Check prototype photos for the era and region you model to see what is appropriate for what you're modeling.

LPG trucks

As chapters 3 and 6 discussed, liquified petroleum gas (LPG), a mixture of propane and butane, began being marketed as a home heating fuel in the early 1930s. As local LPG dealers began appearing, especially in small towns and rural areas where natural gas pipelines didn't reach, dealers needed trucks to deliver the product to customers.

Most early home installations used pairs of vertical 100-gallon "bottle" tanks, and LPG dealers swapped out the new tanks during deliveries. These require a stake-bed or van truck to carry the tanks. By the 1940s and '50s, it was becoming more common for homes to have permanent 500-gallon tanks. These required bulk trucks to refill them.

The pressure tanks on these bulk trucks are cylindrical with hemispherical ends, placed lengthwise on the truck chassis. Early trucks sometimes had pairs of smaller tanks placed side by side, creating a lower center of gravity than a single large tank. By the 1960s, single large tanks were typical, with

MODELING TIPS

Several manufacturers, notably Mini-Metals, have marketed fuel delivery trucks with a variety of prototype oil company paint schemes. You can personalize these by using decal or dry-transfer lettering to add the name of the local fuel dealer or jobber on the cab or body. Walthers offered an older LPG body in a resin kit, and Showcase Miniatures has sold a modern LP truck.

Not as many semi trailers have been offered. Mini-Metals has offered some, and there are older models from Wiking and Ulrich, but they require some work. Trucks 'n' Stuff has offered modern gasoline and LPG trailers, as has Herpa. Also check 3-D printed models through Shapeways.com and other services.

The large transport trucks serving tank terminals in over-highway service tend to be newer models, but many local jobbers (especially through the 1960s and 1970s) used their equipment for a long time, as local delivery trucks didn't pile up mileage like highway trucks. This provides a good opportunity to model older vehicles realistically. As an example, if you model 1970, perhaps a local jobber has a larger brand-new 1970 delivery truck, an older, smaller 1963 model, and an even-older 1956 truck as a backup. Larger businesses will have more trucks.

Remember to add hazmat placards (as described in the chapters on tank cars). A truck being loaded or unloaded at a terminal or gas station, with wire hoses in place and the driver overseeing operations, would make for an interesting scene (see page 51).

Early LPG trucks often had pairs of tanks side-by-side on the truck chassis. Dealers often sold and serviced appliances and furnaces, as well. *Mont Switzer collection*