and down—compressing the bag when raised, and stretching it to its natural length when lowered. To make the vessel rise and fall perpendicularly, the two rods were passed through holes in the plank. Water was kept in the cistern as high as the plank, so that when the movable vessel was raised the contents of the bag would be forced into the upper vessel and expelled through the jet pipe, and when it was again lowered the water would enter through this valve and fill both as before. These engines, he observes, had sometimes two levers and were worked by two men, "the lower brasse (vessel) being poysed with two sweeps."

The goose-neck was used in England at that time. It is not represented in the figures, which are very indifferently executed, but it is sufficiently well defined in the description of one of the engines. The author directs a hollow ball to be placed on the orifice of the forcing pipe, "having a (jet) pipe at the top of it, and made to screw another pipe (elbow) upon it, to direct the water to any place."

Small hand engines continued to be employed in London in the 18th century. This appears from a law passed in the 6th year of Queen Anne's reign, by which it was enacted that "each parish shall keep a large engine, and a hand engine, and a leather pipe, and socket of the same size as the plug or fire cock (of the water mains), that the socket may be put into the pipe to convey the water clear to the engine," under a penalty of ten pounds. In case of fire, the first person who arrived with a parish engine to extinguish it was entitled to thirty shillings, the second twenty, and the third ten, provided the engines were in good order, "with a socket or hose, or leather pipe." The following year the owners or keepers of "other large engines" (not parish engines) were entitled to the same reward upon arriving with them and assisting in extinguishing a fire.

It is a singular proof of the general ignorance of hydraulic machinery, or want of enterprise in London pump makers of the 16th and 17th centuries, that they so long continued the use of "squirts" and engines with single cylinders, when they had daily before their eyes in the Thames waterworks examples of the advantages of combining two or more to one pipe. The application also of such machines as fire engines was obviously enough shown to them, for when Maurice had finished his labors in 1582, the mayor and aldermen went to witness an experiment with his pumps at London bridge: "And they saw him throw water over St. Magnus's steeple, before which time (says Stow) no such thing was known in England as this raising of water." Immediately subsequent to the above date, the "squirt" manufacturers might surely have imitated Maurice's machine, but they did not for nearly a hundred years afterwards, that is, not until such engines had been introduced a second time from Germany, and designed expressly to put out fires.

Before the improvements of Newsham and his contemporaries of the 18th century, some important additions would seem to have been made in England, since, previous to 1686, "the engine for extinguishing fire" was claimed as an English invention. This is stated in a small volume published that year in London by John Harris, and apparently edited by him. It is entitled "A pleasant and compendious history of the first inventors and institutes of the most famous arts, misteries, laws, customs and manners in the whole world, together with many other rarities and remarkable things rarely made known, and never before made public, to which is added several curious inventions, peculiarly attributed to England and Englishmen."

The fire engine which Schottus witnessed in operation at Nuremberg in 1656, appears to have been equal to any modern one in the effects ascribed to it, since it forced a column of water, an inch in diameter, to an elevation of eighty feet. One German author says a hundred feet. It was made by John Hautsch, who, like most of the old inventors, endeavored to keep the construction of his machine a secret. He refused to allow Schottus to examine its interior, though the latter it is said readily conceived the arrangement, and from his account it has been supposed the cylinders were placed in a horizontal position. The cistern that contained the pumps was eight feet long, two in breadth, and four deep; it stood on a sled ten feet in length and four in width, and the whole was drawn by two horses. The levers were so arranged that twenty-eight men could be employed in working them. The manufacture of these engines was continued by George Hautsch, the son, who is supposed to have made improvements in them, as some writers ascribe the invention of fire engines to him.

In the 16th century, no place could have furnished equal facilities with Nuremberg for the fabrication of, and making experiments with, hydraulic machines. It was at that time the Birmingham of Europe. "Nuremberg brass" was celebrated for ages. Its mechanics were so numerous that, for fear of tumults, they were not allowed to assemble in public "except at worship, weddings and funerals." No other place, observes an old writer, "had so great a number of curious workmen in metals." The Hautschs seem to have been favorites with the genius of invention that presided over the city; an aptitude for, and an inclination to pursue, mechanical researches were inherited by the family.

For nearly a hundred years after the date of Hautsch's engine, those used throughout Europe, with the exception, perhaps, of a few cities in Germany, were very similar to those described by Belidor, as employed in France in his time. They consisted simply of two pumps placed in a chest or cistern that was moved on wheels or sleds, and sometimes carried by men like the old sedan chair. These engines differed from each other only in their dimensions and the models of working them. One belonged to Strasbourg, the other to Ypres. The front part of the cistern in which the pumps are fixed is separated by a perforated board from the hinder part, into which the water was poured from buckets. The cylinders were four inches in diameter, and the pistons had a stroke of ten inches. Each pump was worked by a separate lever, an injudicious plan, since a very few hands could be employed on each, and as the engine had no air vessel, it was necessary, in order to keep up the jet, that the piston should be raised and depressed alternately—a condition not easily performed by individuals unused to the operation, and acting under the excitement of a spreading conflagration. The contrivance for changing the direction of the jet was very defective, and considering the date of the engines, it is surprising that such a one was then in use. A short leathern pipe would have been much better. The jet pipe was connected to the perpendicular or fixed one by a single elbow, instead of a double one, like the ordinary goose-neck. The joints were also made differently. The short elbow piece had a collar or ring round each end, and the jet and per-