Development and Production of the New Holland Gasoline Engine: The Contributions of Abram M. Zimmerman

by Richard A. Weymer

Throughout the ages, humankind had dreamed of a source of economical, reliable, and portable power that people would not have to hitch, feed, or stable. Humankind was searching for power that could be turned on, and just as quickly, turned off. During the 19th century, we were close in our quest for this power source. Advancements had been made in the generation of steam power. Steam engines moved the railroads and powered the factories of the Industrial Revolution. But, steam power had limitations. Steam engines were large, cumbersome, and expensive. Appendages had to be dealt with for boiling water, storing fuel, and for transporting the steam to the engine. What was needed was a new technology: a new prime mover. In 1876, Nikolaus August Otto provided this technology in the form of his four-stroke cycle compression internal combustion (I-C) engine.

There was much change in the area of farm mechanization at the turn of the century. In 1892, John Froeliech of Iowa designed and built the first self-propelled tractor with an I-C engine (Devore, 1980). This development was the beginning of the second age of power in agriculture. The evolution of the second age was started with steam power and concluded with the introduction of the I-C engine. Rotary power was needed to drive all the new innovations: corn cob breakers, feed mills, silo elevators, wood saws, threshing machines, and pumps.

New Holland, Pennsylvania, was a small farming community at the turn of the century. Several technological developments lead a young machinist with a farm background, Abram M. Zimmerman, to form a manufacturing company specializing in the production of mechanical conveniences for the farmer. The development of the Otto Cycle Engine played a significant role in the formation of Zimmerman's company, The New Holland Machine Company. Prior to the incorporation of the New Holland Machine Company in 1903, one of Zimmerman's goals was to develop usable rotary power for the farmer.

Zimmerman experimented with steam, wind, and finally, with the I-C engine. In 1897, Zimmerman actually developed a wind motor, "The Ideal Wind Wheel." But it never went into production (*New Holland Clarion,* December 25, 1897). Zimmerman was focusing his energies on the I-C engine. He realized that this technology would be the prime mover of choice for farm use. This superior source of rotary power soon replaced steam, horse sweep, and horse treadmill power. By 1902, Zimmerman's shop had designed and built a 1½ horsepower (HP) I-C engine. In 1903, a stock company with assets of $50,000 was formed (*Clarion,* May 2, 1903). This capital built and equipped a facility for engine production.

In America, the Otto Engine was produced under license in Philadelphia, Pennsylvania, by Schleicer, Schumm, and company (Cummins, 1976). Zimmerman successfully converted one of these engines, which was set up for manufactured gas, to run on gasoline. Zimmerman received a patent for this gasoline vaporizer (*Clarion,* April 18, 1903).

In 1898, Zimmerman took out a franchise for the Columbus I-C Engine (*Clarion,* February 24, 1912). Zimmerman designed and produced his version of the Otto I-C Engine in 1901-1902. The portable single cylinder Otto type (style) engine proved to be a useful technology until the I-C engine powered tractor, the electrification of rural areas (electric motor), and the small gasoline engine replaced them in the 1920s and 1930s.

Biography of Abram M. Zimmerman

Abram M. Zimmerman had a farming background. Working on a farm until the age of fourteen, he performed such diverse jobs as: running steam traction engines, operating threshing machines, crushing rocks, hauling, road scraping, and well drilling (*Clarion,* February 24, 1912). At age fourteen, Zimmerman left the farm and worked at several trades. At the age of nineteen, Zimmerman went to work for Ezra F. Landis Machine Works in Lancaster, PA.

Zimmerman was committed to learning the machinist trade. His own testimony follows:

> With amazement in our younger days we looked upon small manufacturers and repair shops wondering why they did not get busy and increase to help the enormous demand for all kinds of machinery. My ambition and courage would have failed in my early days had I known how much strenuous effort and the difficulties required and connected when starting and increasing a new manufacturing plant or a new product to a scale where it afforded modern machinery.
>
> We feel confident that only large manufacturing concerns with modernly equipped plants and whose heads are willing to improve their products as the demand requires it, will be the only ones to meet with success in the future. (*Clarion,* February 24, 1912)

This testimony, seventeen years after the founding of the New Holland Machine Works in 1895, speaks strongly of Zimmerman's character and work ethic. There is no doubt that he was ambitious. He worked for Landis learning the machinist trade by day. By night, he augmented his hands-on learning with book learning. After serving his apprenticeship, Zimmerman worked for Peter Shirk, owner-founder of the Blue Ball Machine Works.

Abram Zimmerman was the type of person who was always tinkering and improving on others' ideas. The stage was set for Zimmerman to make his lasting contribution in New Holland. He had mastered the machinist trade, he had a diverse mechanical background, and he was ready to start out on his own.

The New Holland Machine Works (1895-1903)

In 1895, Zimmerman left Peter Shirk at the Blue Ball Machine Works and went into business for himself. An article in the May 30, 1986, *New Holland Clarion* describes this facility as consisting of two frame buildings, each being approximately 30′ × 40′. One building contained a 12HP boiler, which Zimmerman constructed for powering the steam engine used for driving machinery.

This facility probably had a foundry, as many of the products he manufactured in this period contained cast iron parts. Zimmerman advertises for pattern making services in the December 25, 1897, *Clarion.* This article, coupled with the development of an I-C engine that required many castings provides strong, but inconclusive, evidence of the existence of a foundry at the New Holland Machine Works.

No mention of the machine tools used at the New Holland Machine Works has been found. Zimmerman's shop was probably well equipped, because a wide range of fabrication processes was used in the manufacturing of his early products.

Zimmerman advertized extensively in the *New Holland Clarion* between 1897 and 1903. In order to view the evolution of Zimmerman's work at the New Holland Machine Works, brief yearly summaries of his accomplishments follow:

1895

Zimmerman estabished a business on Luther Avenue. He repaired machinery and boilers (*Clarion,* May 30, 1896).

1896

Zimmerman manufactured boilers, water troughs, water tanks, etc. Tools and machinery were purchased and three men were employed (*Clarion,* May 30, 1896).

1897

The "Ideal Wind Motor" was developed, but not produced. Tanks, tank pumps, patterns, and experimental work of all kinds were performed. Engines and boilers were repaired. A portable feed mill with sandstone buhr wheels was developed (*Clarion,* December 25, 1897). A 12" sandstone mill was also developed and five people were employed (*Clarion,* February 24, 1912).

1898

Second-hand gas engines were purchased, repaired, rebuilt, and studied. The agency for selling the Columbus Gas Engine was secured. Repair work on steam engines was done and an engine truck with steel wheels was manufactured (*Clarion,* February 24, 1912). A cob breaker was developed and produced for shelling corn. Zimmerman converted a 12 HP Otto Engine to run on gasoline (*Clarion,* December 3, 1898).

1899

A patent was received for a cob grinder featuring an adjustable opening in the grinding plate. Eight people were employed (*Clarion,* February 24, 1912).

1900

An improved cob mill was produced and sold through advertising in a farm paper. I-C engines were sold and repaired (Columbus). Ten people were employed (*Clarion,* February 24, 1912).

1901

A large growth in sales was experienced for the cob mill. A steel truck was produced for the Columbus Engine. A clutch pulley was designed and manufactured for the Columbus Engine. A 1½ HP I-C Otto Cycle Engine of Zimmerman's design was built. Employment had increased to seventeen people (*Clarion,* February 24, 1912).

1902

A larger improved cob mill was introduced for sale. The New Holland 1½ HP engine was improved. A two-wheel truck was built for this engine. Business growth was so strong that plans were made to form a stock company for the purpose of building and equipping a new facility (*Clarion,* March 21, 1903).

1903

The New Holland Machine Corporation became a stock corporation chartered in Harrisburg, PA (*Clarion,* May 2, 1903). $50,000 was raised by the sale of 500 shares of stock. A new facility was built on Franklin Street. Patents were received for the "freeze proof" engine and gas vaporizer. Forty people were employed (*Clarion,* February 24, 1912).

The New Holland Machine Works had clearly outgrown its plant on Luther Avenue. With a strong business in cob mills and the prototype New Holland Gasoline Engine ready to be manufactured, Abram M. Zimmerman was a successful businessman.

It was sales of the cob mill that financed Zimmerman's best known achievement, the New Holland Gasoline Engine. Cob mill sales must have continued to be strong as production of the gasoline engine didn't reach significant numbers for several years. In addition to cob mills and gasoline engines, the New Holland Machine Company manufactured and sold: rock crushing equipment, wood saws, home furnaces, and other products.

New Holland Machine Company

In 1903, the incorporation of the New Holland Machine Company finds production shifting to a new plant. First mention of the need for a larger facility appears in the March 21, 1903, *New Holland Clarion.* An article on page two states that the new facility is being erected in order to increase production and reduce cost of manufacturing. It is inferred from this article that Zimmerman had several products sufficiently refined that a more efficient means of production would result in a cost savings. The new facilities

needed to be modern and well equipped to be competitive in the marketplace.

The State Department of Pennsylvania granted the New Holland Machine Company a charter on April 27, 1903, (*Clarion,* May 2, 1903). One day later, ground was broken on a two acre lot on Franklin Street, along the Downingtown and Lancaster railroad, in the Borough of New Holland. The following brick buildings were constructed: a 40′ × 210′ main building and a 40′ × 50′ foundry. A powerhouse, containing a 40 HP boiler and a 25 HP steam engine, was built as was a warehouse. Modern equipment was purchased and installed and the new facility was to be ready for operation by the fall of 1903. (*Clarion,* May 2, 1903).

Facilities and Production

A listing of equipment and processes known to have been used by the company will shed some light on the manufacturing process and the production of the engine. It is important to note that New Holland produced all of its engine parts at the New Holland plant, except for the electrical systems (Kreider, 1985). Deduction of manufacturing processes is supported by photographs and written information.

The Foundry

A foundry was originally housed in a 40′ × 50′ brick building. The melting of iron for castings was accomplished in a cupola. An 85′ × 100′ brick building was built in 1907 for additional foundry space. This building remained vacant until 1909 due to a weak business climate (*Clarion,* February 24, 1912).

Molding was done manually until 1911, when automatic molding equipment was installed. The rational for adding this equipment was to increase output and lower production costs. At the same time, the molding machines were installed, a long narrow addition was constructed to house the core room, coke ovens, and casting cleaning equipment (*Clarion,* February 24, 1912). The cleaning of castings was accomplished with a tumbling machine driven by an overhead belt. An article in the *New Holland Clarion* on July 1, 1905, describes this machine and an injury that a worker received while operating it.

Machine Tools

Machine tools in use during the time period of engine production were capable of very accurate work. All the basic machine tools presently in operation existed in some capacity during the engine producing years.

Little is known of the actual equipment that New Holland had in its machine shop. Much of the information must be deduced by examination of the products the New Holland Machine Company produced. Where actual equipment was known to exist, a more thorough report of these machine tools is given. This is not a complete list of tools in use, but is probably representative.

A photograph, circa 1913, shows a vertical boring machine in operation (Kreider). This machine is seen boring an engine block. Steeds (1969) describes the use of this tool. The boring machine consists of a large arch or portal frame constructed of two columns united at the top by a bridge member that carried the driving mechanism for the spindle. The arch was fixed to a base casting that carried the work and also provided a bottom bearing for the boring bar along which the cutter head traveled.

Turret lathes were introduced in 1911 (*Clarion,* February 24, 1912). A turret lathe had the advantage of bringing several preset tools to the work, thus saving set-up time and increasing production. Less skill was also needed to operate this tool than a conventional lathe. Turret lathes were probably used to make bearings, bushings, pistons, rings and cams. It is possible that a special (i.e., designated) lathe was set up for turning the crank shafts.

Grinding machines were used to finish the crank shafts and pistons. This process was used mainly for finishing hardened articles and when great accuracy was required (Steeds, 1969). Steel gears were made and used on the engine to time the valves. Gears could have been produced by milling machines or special gear-cutting machinery. Other processes in use in the machine shop were keyway cutting, threading, drilling, grinding, and stock cutoff.

Materials

In the *New Holland Engine Owner's Manual* it is learned that the engine block, rings, and piston were made from semi-steel. Semi-steel is cast iron to which steel scrap has been added to increase strength. It is probably the most effective way of obtaining cast iron with high tensile strength and transverse strength. The crank shaft was forged from high carbon steel. This process and material made for a high quality crank shaft. The gears were cut from high-grade steel and the crank shaft bearings were produced in phosphor bronze (*Owner's Manual*).

Assembly

The New Holland Machine Company was a complete engine manufacturing plant. The foundry produced the basic parts of the engine in cast iron. The machine shop milled the castings to the required tolerances and

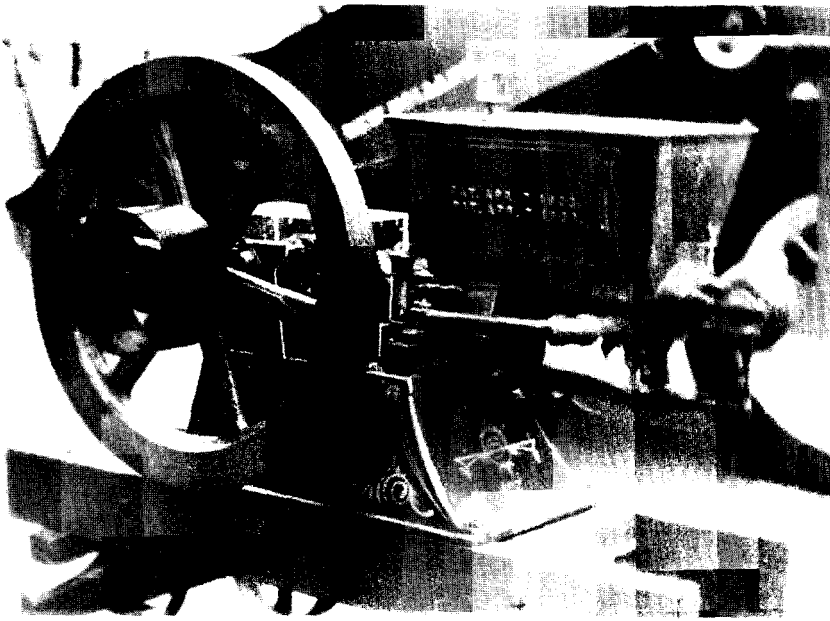

Figure 1
The 1½ HP New Holland Engine showing the dates (April 7, 1903) of Zimmerman's gasoline vaporizer and "freeze proof engine" patents.

produced the necessary fittings, shafts, valves, and other engine parts needed. Engines were assembled out of parts as orders were received.

Assembly of the New Holland Engine was accomplished in an unusual fashion. Upon completion of making the part(s), the machinist would fit the part(s) to an engine (Kreider, 1985). This manual assembly technique resulted in a quality product. Production levels never reached levels necessitating assembly lines. The engines were produced in small "batches" dictated by demand. The engines were finished (e.g., painted) as subassemblies prior to final assembly (Garden Spot Jr. High School, photograph, circa 1913). The New Holland Machine Company had warehouse facilities and was located on the rail line. Engines were stored after assembly until they were shipped.

Description of the New Holland Gasoline Engine

The New Holland Gasoline Engine was a horizontal shaft, single cylinder, water cooled I-C engine (see Figure 1). The engine had a unique rocker arm

arrangement for working the valves. Also unique was the tapered cooling jacket on top of the cylinder. Cold weather could not crack the engine block, which was a common problem with other manufacturers' engines. The frozen cooling water (ice) was permitted to lift free of the water jacket. This patented design was later copied by other engine manufacturers. The engines, except the 1½ HP model, had two large flywheels on either side of the crank shaft. The gasoline tank was in the cast iron base and was underwriter approved by 1912 (*Clarion,* February 24, 1912). Ignition was electrical, either by battery or by magneto. Lubrication was provided by drip type lubricators. These engines were usually fitted with a truck. Although they were classified as being portable, the 5 HP model weighed 950 pounds! (*Owners Manual*).

The New Holland Engine was produced in six sizes between 1902-1927. It is possible that engines were sold as late as the early 1940s out of stockpiled parts, even though production ceased on September 15, 1927 (Martin, 1985). The total number of engines produced was 10,028 (Kreider, 1985). The New Holland Machine Company numbered their engines consecutively.

It should be noted that some error in the total number of engines produced from 1903-1914 exists. Records of sequential numbering exist for the years 1914-1927. Production between 1903 and 1913 suggests approximately 25% more engines were listed as having been built than the company records, starting in 1914, indicate (see Table 1).

New Holland Engines' models and approximate years of production follow:

½ HP Production began 1910 (*Clarion,* April 22, 1911). Production ended 1920 (New Holland Machine Company Production Records).

1½ HP Production began 1902 (*Clarion,* February 24, 1912). Production ended 1927 (Production Records).

2 HP Production began 1910 (*Clarion,* April 22, 1911). Production ended 1927 (Production Records).

3 HP This engine was probably introduced in 1907 (*Clarion,* September 12, 1908). Production was short lived, probably ending in 1907-1908. The 3 HP engine evolved into the 4 HP engine in 1908.

4 HP Production began 1908 (*Clarion,* February 24, 1912). Production ended 1918 (Production Records).

5 HP Production began 1910 (*Clarion,* April 22, 1911). Production ended 1927 (Production Records).

Table 1
Production Figures: New Holland Engine

Year	Quantity	Serial Number Start of Year	Serial Number End of Year
1927	100	9,929	10,028
1926	126	9,803	9,928
1925	149	9.654	9,802
1924	140	9,514	9,653
1923	250	9,264	9,513
1922	212	9,052	9.263
1921	264	8,788	9,051
1920	611	8,177	8,787
1919	511	7,668	8,178
1918	581	7,087	7,667
1917	562	6,525	7,086
1916	475	6,050	6,524
1915	4441	5,825[a]	6,049
1914		1,609[b]	—
1913	450[c]	—	—
1912	—	—	—
1911	—	—	—
1910	565[d]	—	—
1909	360[d]	—	—
1908	219[d]	—	—
1907	146[d]	—	—
1906	162[d]	—	—
1905	159[e]	—	—
1904	112[e]	—	—
1903	—	—	—
1902	—	—	—

[a]New Holland Machine Company Production Records, September 13, 1915 [b]Production Records, January 1, 1914 [c]Approximate number of engines produced [d]Quantities for the years 1906-1910 from the *New Holland Clarion*, February 24, 1912 [e]Quantities for the years 1904 and 1905 from the *Clarion*, April 28, 1906.

Impact on Community

New Holland Borough's growth during the years 1900-1930 is summarized in Table 2. In terms of population growth, The New Holland Machine Company probably brought many people into the community.

New Holland showed an increase in population of 32% during the years 1910-1920. The United States' population (Table 2) shows a growth of 15% in the same period. Comparing Table 1 and Table 2 for the peak engine production years of 1910-1920, we see a dynamic growth in New Holland's population.

Table 2
Comparison of Population Growth

	New Holland		United States	
Year	Number	Percent	Number	Percent
1900	902[a]		76,300,000[a]	
1910	1,106[b]	22%	91,972,266[b]	20%
1920	1,453[c]	32%	105,710,620[c]	15%
1930	1,725[c]	19%	122,775,046[c]	16%

[a]U.S. Census, Population Schedules, 1901. [b]U.S. Census, Population Schedules, 1913. [c]U.S. Census, Population Schedules, 1931.

Employment figures (Table 3) for the period 1910-1920 show an increase in employment of 33%; therefore, the increase in the work force probably contributed in a positive way to New Holland's dynamic growth between 1910-1920. In addition to population growth in the Borough of New Holland, the growth of the machine company brought more wages into the community. Population growth, which was 17% above the national average during peak production years, indicates the increased need for consumer goods (i.e, houses, durable goods, perishable goods, and services).

Table 3
Employment Growth at The New Holland Machine Company

Year	Work force	Increase
1900	10	—
1910	135	1,350%
1911	150[a]	11%
1920	180[b]	33%
1927	225[c]	25%

[a]*Clarion,* February 24, 1912 [b]1920 figure extrapolated. [c]*Line,* March 1970, p.6

An important impact of the New Holland Engine on the Borough of New Holland that can be viewed today is the Ford-New Holland Corporation.

Growth in the company during the peak production era increased the need for foremen, apprentice mechanics, and management personnel. According to Zimmerman in the *New Holland Clarion* of February 24, 1912, it was company policy to promote from within. This suggests that training was practiced at the plant and that the company cared about its employees.

Impact on Consumers

Primarily an evolutionary technology with a relatively short lifespan (30 years), the New Holland Engine impacted on its users in a positive way. The engines were important mainly in agriculture where they provided an economical and reliable rotary power source for driving an increasing number of time-saving machines.

This study, although specifically about the New Holland Engine, could have been written on any of the hundreds of small companies in America producing similar engines. The New Holland Machine Company's engines were a regional phenomenon. If the single cylinder engine patterned after the first generation Otto Engines is viewed generically, then the millions that were produced in America until the 1930s become a significant technology.

Summary

Abram M. Zimmerman refined an existing technology with two improvements. His patent for a gasoline vaporizer made the engine portable so that it could be used away from the city gas mains. Zimmerman's patent for the "freeze proof" engine meant that the cooling water would not have to be drained from the engine after use.

Perhaps the genius of Abram M. Zimmerman was not these common sense technical refinements, but his ability to successfully start a large manufacturing facility. The New Holland Machine Company played a significant role in the growth of New Holland by supplying jobs, wages, taxes and an influx of people.

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