"OLD TWIN", "NEW TWIN" THE LOMBARD A-O-L

Terence F. Harper
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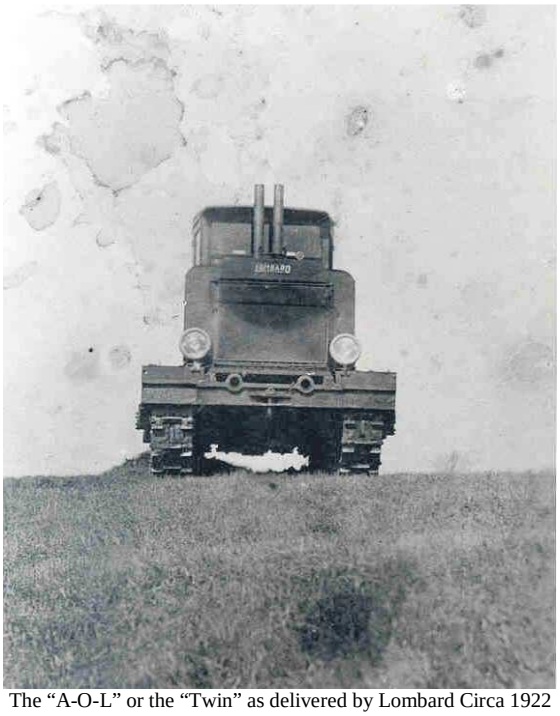
Interestingly, in spite of Lombard's success in developing and producing the steam Lombard Log Hauler, which is recognized as the world's first successful crawler tracked vehicle to be put into production, and the heated legal wrangling with Holt in regards to patent infringement as well as Lombard's continuous attempts to broaden his market base, Lombard made only one foray into the "full track" market. Like his big halftracks, this machine was intended for hauling timber and pulpwood and was constructed in response to a request by the Great Northern Paper Co. of Millinocket, Maine - one of Lombard's long standing and valued customers. The creation of this unique tractor and its extensive remodeling by O.A. Harkness has lead to a bit of confusion for Lombard historians. Some have claimed that the Old Twin/New Twin was in fact two distinct machines whereas others have dismissed it as an anomaly and overlooked its design merits which, as you will see, are considerable.



The "A-O-L" or the "Twin" as delivered by Lombard Circa 1922
Terence F. Harper Collection

At the time Great Northern Paper Co. was operating an extensive fleet of Lombard Auto-Type tractors. These of course were the standard 10 ton halftracks. In what seems to have been a Great Northern preference, most of these were powered by Sterling Model F engines (6 cylinder, T-head engine with a 5-1/2" bore and 6-3/4" stroke, 145 hp at 1,200 rpm.)

In 1920, in an effort to mechanize their woods operations even further, Great Northern experimented with Holt "Caterpillar" tractors built by the Holt Manufacturing Co. of Stockton, California. The Holt tractor was known as a full track or "tank type" machine - to use the terminology of the day. Holt would eventually develop and dominate the crawler tractor market as the colossal Caterpillar Corporation.

hTe A-O-L (Old Twin) factory fresh, 1922
Terence F. Harper Collection

During these trials It was quickly realized that tank type tractors such as the Holt and similar tractors produced by C.L. Best, with their wonderful maneuverability, were ideally suited to the task of hauling sleds over the rough trails from the cuttings to the main haul roads where the sleds would be assembled into long sled trains and hauled to the landing by the much more powerful and faster half track Lombard tractors.

Following the success of these experiments, Great Northern purchased 39 Holt "Caterpillar" tractors for use during the winter of 1920-21[1] claiming that these tractors would perform the work of 800 horses [ibid] and improve efficiency immensely.

[1] Pulp And Paper Magazine, *"Tractors For Great Northern"*, September, 23, 1920

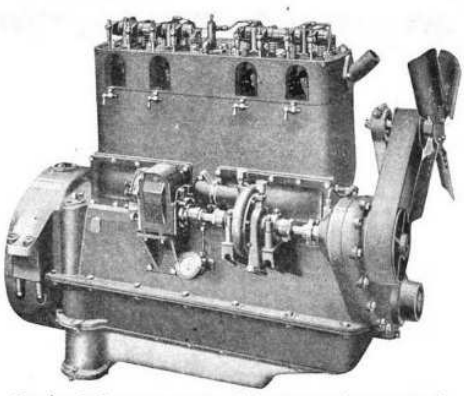
While the Holt caterpillar tractors excelled at this task, they were not well suited for long distance hauling at what was considered fast speeds. (7-12 mph) Nor could they pull the required tonnage. One limiting factor, in addition to horsepower and weight constraints, was the power loss through the early steering systems.

The A-O-L (Old Twin) at the Lombard factory. Note the twin Stearns engines
Terence F. Harper Collection

At that time there were four recognized steering systems, differential (much like the differential in a rear-wheel drive car), planetary fixed ratio type, selective speed type and last - the Holt separate clutch drive type.[2] In the Holt tractor a separate clutch was used in the drive to each track. Brakes for each track were used for additional steering control. Of the four the "Holt" type was considered the best in regards to efficiency and minimizing loss of power while turning.[ibid] In the Holt type, when running straight ahead, power was applied to each track equally at all times. However, when turning, with the clutch disengaged on one track, power was lost to the inside track. Meanwhile, all the power was transferred to the engaged outside track which under certain circumstances would result in a loss of traction. Added to, this with the early steering mechanisms, it was difficult, if not impossible to negotiate a corner or bend in the road in smooth arc such as you would with an automobile. Instead a corner or bend was taken in a series of tangents with inconsistent power being applied to both sets of lags at the end of each tangent. This made operation over long distances tiring and inefficient.

The other limiting factor in regards to the Holt and C.L. Best "tank type" tractors was their use of a rigid track system which, like a modern bulldozer, lacked any form of suspension. This caused the machines to plunge violently up and down as they negotiated rough terrain placing great strain on the draw bars of the sleds and limited their speed accordingly. Conversely the big halftrack Lombard's excelled at long distances (20 mile hauls were not uncommon), and were unmatched in regards to pulling power. However, with a 50ft. turning radius they lacked maneuverability and were thus limited to the main haul roads. What Great Northern requested was one machine to do it all - i.e. a full tracked or "tank type" machine that had the maneuverability of a Holt or C.L. Best, with the speed and stability of a Lombard and could maintain relatively constant power to the tracks at all times. A tall order for 1921!

Nevertheless *"The Lombard Traction Engine Company has designed this machine to fulfill the requirements where their old type machine cannot be used. This machine is known as the A-O-L type and has given some very good demonstrations."*[3] There is some speculation as to whether this represented Alvin Orlando Lombard's initials or was an acronym for "All-On-Lags" as Lawrence Sturtevant suggests.[4]

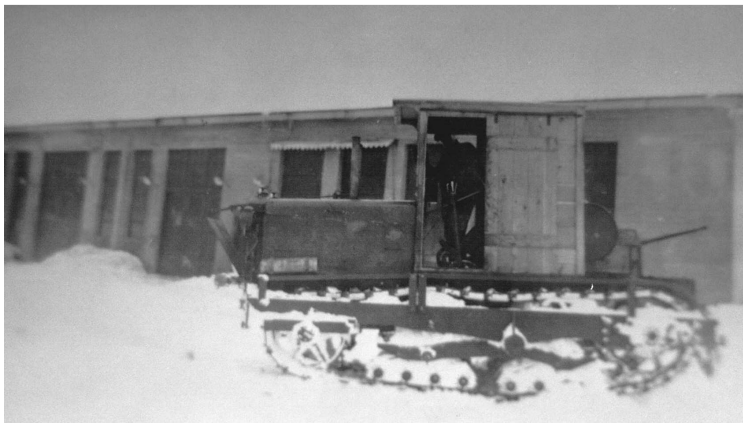


The A-O-L or "Old Twin" used two four cylinder Stearns engines (as shown above) sharing a common crankcase.
Motor Age, April 29, 1920

[2] Army Ordinance, *"Final Drive for Combat Vehicles"* May-June 1921, pg. 328

[3] Harkness, O.A., *"The Northern"*, Great Northern Paper Co., May 1922

[4] Sturtevant, Lawrence M., unpublished manuscript, *"Lombards of Maine : inventors for the Penobscot frontier"*



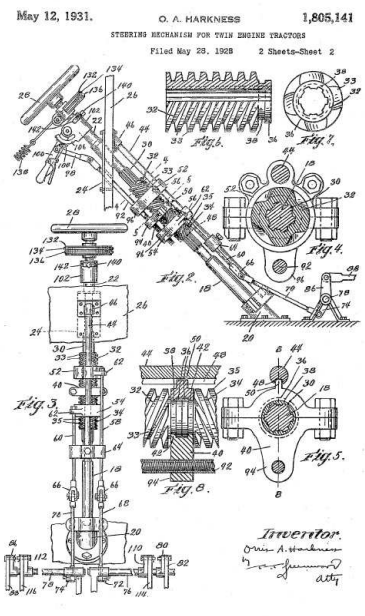
Louis Lombard puts the "New Twin" through its paces at the G.N.P. Co. Greenville, ME. Shop, Feb. 1927.
Terence F. Harper Collection

The resulting tractor was powered by two four cylinder engines provided by the Stearns Motor Manufacturing Co. of Ludington, Michigan. Stearns began life as the Giles Tractor and Engine Company in 1909. In 1914 J.S. Stearns (one of the original founders of the firm) became the sole stockholder and re-named the firm the Stearns Motor Manufacturing Company. [5] By the 1920's Stearns with slogan "Extra Reserve" in reference to the strength provided by very large main and crankpin bearings and a forged and heat treated crankshaft[6], was a well established manufacturer of marine and industrial engines and would last until 1930.
The Stearns engine in the A-O-L was unique to say the least. Based on a standard model introduced in 1920, it featured a bore of 4-3/4" and a stroke of 6-1/2" inches and developed 41 hp at 800 rpm.[7] What made this engine unique in the A-O-L was that the crankshafts of the two engines shared a common crankcase - with one engine turning clockwise and the other counter clockwise. The drive train featured two clutches and two transmissions in a common case and what amounted to two differentials mounted in a common case as well. In reality each track was driven independently.[2]

Steering was via a steering wheel which caused one engine to speed-up while retarding the other one "Thus changing direction without losing power to the lag beds" as described by Frederick Van Schenck Superintendent of Great Northern's Greenville Maine machine shop.[8] In addition to its unique duplex drive train, the A-O-L featured an advanced sprung and flexible track system. The weight of the machine was supported on each track by two sets of 16 steel rollers arranged in groups of 8. Each group of rollers was connected to a central pivot point near the midpoint of the chassis by a lever arm. Each lever arm supported the front or rear of the chassis with a set of heavy coil springs. This allowed for remarkable flexibility and cross-country performance. Interestingly Lombard never patented this unique design.

Dubbed "The Twin" by Great Northern Paper's Greenville shop crew the tractor was extensively tested through 1922. While the tractor indeed proved itself superior to the Holt and Best designs, Schenck stated that it "had weak points." [ibid] Under the direction of O.A. Harkness – of Eagle Lake Tramway fame - and Master Mechanic for Great Northern Paper - the tractor was dismantled and completely rebuilt in Great Northern's Greenville, Maine shop. During the lengthy rebuild most of the design work was performed by Harkness's design staff. While the Lombard plant provided machined castings for assembly in Greenville.[ibid]

Referred to as "The New Twin" this revised edition featured two Wisconsin engines (5-3/4"x7") each engine developed 63 hp at 800 rpm. In light of the standards of the day, adequate horsepower would not be an issue! Each engine ran independent with its own clutch, transmission and differential. The common crankcase of the previous design



Steering for the "New Twin" as patented by O.A. Harkness
United States Patent Office

[5] Kreitler, Dave, Gas Engine Magazine, "*Giles Tractor Notes"*, January –February, 1977
[6] Grayson, Stan, "*American Marine Engines"*, 1885-1950, pg. 203
[7] Motor Age, "*Stearns Tractor Engine"*, April 29, 1920
[8] Van Schenck, Frederick, "*The Northern"*, Great Northern Paper Co., April 1927

was discarded. Again, a steering wheel was used employing an ingenious though complex system to throttle the engines via both the throttles and engage and disengage the governors which limited the rpm's of the engine. Developed by O.A. Harkness, he would later be granted a patent (1,805,141) for this design. With a top speed of 8 mph and a combined 126 hp, it was indeed a powerful machine. Exactly how much involvement the Lombard firm had in the redesign of this machine is not known apart from the factory providing machined castings from the Great Northern's drawings. However, photos and vintage film of the completed tractor show Louis Lombard at the controls with E.W. Englebright (Vice-President Lombard Tractor and Truck Corp.) and their consulting engineer - S.L.G. Knox where present at the trials.[ibid] Both Englebright and Knox, were capable men. Englebright had a long association with railroad engineering including being assistant engineer for motive power and equipment standards for the Union Pacific railroad. In 1922 Englebright became the vice-president of the Elvin Mechanical Stoker Company [9] and subsequently, in 1925, the vice-president of the Lombard Tractor and Truck Corporation – a position he would fill until 1932.[10]

E.W. Englebright, Vice-President Lombard Tractor and Truck Corporation
1925-1932
Railway Maintenance Engineer, January 1921

S.L.G. (Samuel Lippencott Griswald) Knox, after leaving General Electric in 1902, served as Chief Engineer and Manager of the Bucyrus Company.[11] Under his direction Bucyrus became the top manufacturer of steam shovels and Knox a recognized authority after he successfully championed their use on the Panama Canal project[12]. An inventor at heart, Knox held at least fourteen patents. At the close of the Great War he spent time in Belgium and developed a machine used to fill-in trenches used during the war[13]. Later, in 1923, he would serve as the court appointed receiver for the Stanley Motor Carriage Company.[14] In 1927 Knox was serving as a engineering consultant to the Lombard Tractor and Truck Corporation. By 1928 Knox would be listed as president on company stationary.[15] In Englebright and Knox the company had an upper manager and consultant with strong with strong engineering skills and manufacturing backgrounds. – enough, it would seem, to add significantly to the design and bring a new design successfully to market.

After much delay the "New Twin" made its debut in February of 1927. As hoped it did indeed have the speed (8 MPH) and steering stability of the halftrack Lombards as well as being able to maneuver and negotiate rough ground better than the Holt and Best designs thanks to its sprung rollers. Following testing The "New Twin" was quickly put into services toting supplies from Greenville to various outlying areas. With the apparent success of the "New Twin" the future of the design looked secure. In what appears to be a response to a request from Great Northern, On May 12, 1928 Knox - having become president of Lombard, submitted a proposal to build three "Special Twin tractors" at a cost of $48,900.00. ($16,300.00 each) In addition, to take advantage of scale of production, Lombard stated that if six tractors were ordered than the price would be $93,000.00.[ibid] This, at a time when a standard 10 ton Lombard half-track type tractor cost approximately $7,500.00 [16], meant that these were expensive tractors indeed.

The proposed tractors would be built (for the most part) using drawings and sketches provided by Great Northern Paper Company and no doubt were created during the rebuilding of the "Old Twin" into the "New Twin". Radiators, transmissions, (Cotta type FA) clutches, sprockets (11 tooth) cabs and fuel tanks would be standard components shared with Lombard's halftrack type tractors. The track pads would be similar to Lombard's standard design but were 14 inches wide and used larger 1-1/8" diameter pins. Like the "New Twin" the proposed tractors featured a

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[9] *Railway Age*, June 14, 1922, pg 1,384

[10] *Public management*, vol 20, 1938, pg 250

[11] *Natoma News*, May-June 1911, pg 20

[12] *Stevens Institute Indicator*, vol 24, 1908, pg 211

[13] *Stevens Indicator*, May 15, 1922, pp 62-63

[14] *The Cumulative Daily Digest of Corporation News*, 1923, pg 551

[15] Letter, *Lombard Tractor and Truck Corporation to Great Northern Paper Company*, May 12, 1928, Author's collection.

[16] Sturtevant, Lawrence, unpublished manuscript, *"Lombards of Maine : inventors for the Penobscot frontier"*

The "New Twin" (formally the "A-O-L" or "Twin")
Great Northern Paper Co. Greenville Maine Shop, Feb. 1927
Terence F. Harper Collection

complete but separate dive train for each track – including engine, flywheel, transmission, clutch, drive shafts and final drive. A cast steel drum brake 14-1/2 inches in diameter and 6 inches wide was incorporated into each drive train and was considered to be adequate for braking.

Unlike the "New Twin" they were intended to duplicate, each of the proposed "Special Twin" tractors would use two 4 cylinder Hercules "TXO" engines. (6-3/8"x7"). Steering was via the patented system developed by O.A. Harkness – the proposal specifying the Great Northern would provide the steering column and Lombard would install it. Normal engine speed would be 850 rpm but by simply turning the steering wheel one engine or the other could be sped up to 1,000 rpm. to facilitate steering. The only other noteworthy change from the "New Twin" was that the proposed tractors would be wider by 4 inches.[5]

The Lombard proposal was for not. The last record we have of the "New Twin" - the only one of its kind, was in 1928. By that time it had been equipped with a snowplow designed by Samuel Lombard and was praised for its service in opening the road from Greenville to the Grant Farm [6]. The "New Twin" Thus closes out Lombard's one and only attempt to develop a full track machine.

In retrospect one has to ask the question why only one machine was produced and could this unique design have made inroads into the vast market dominated by Holt and C.L. Best? In regards to the first question; during this time period the Lombard Traction Engine Company went through significant financial turmoil which plunged it into receivership in 1923.[17] Under the guidance of a court appointed receiver - Charles L. Andrews, [ibid] Lombard survived and its assets and controlling interest were purchase by the Elvin Mechanical Stoker Company in 1925 – which brought in a new management team including Englebright who, in December of 1921 had joined Elvin[18] and subsequently, in 1925, was appointed Vice president of Lombard.

Reorganized and incorporation as the Lombard Tractor and Truck Corporation, Lombard did indeed focus on developing new markets beyond the limits of the New England forest industry. However, that focus was on the municipal and heavy haulage for construction – markets long dominated by the halftrack machines developed by H.H. Linn (a former Lombard employee) and manufactured by the Linn Manufacturing Corp. of Morris, N.Y. How production of a tractor such as the A-O-L or New Twin would have fit into these plans is unknown. What is known is that this very unique and unconventional design, even with all its merits, would have had to compete head-to-head with the well proven designs of Holt and C.L. Best who simply dominated the market.

As a result Lombard developed the brutish CS-88 (Contractor Special) and model "GT" powered by massive Climax engines and available as 15 and 20 ton models respectively. At the opposite end of the spectrum was the much smaller 8 ton model "T". Both designs, when equipped with dump bodies, were suitable for heavy haulage. In addition Lombard worked to sell tractors to municipalities for snow remove and highway work. Needless to say with a solid focus on the construction and municipal markets, there is no indication that Lombard was willing to advance into Holt and C.L. Best territory or that Lombard could afford to develop such a complex machine and successfully bring it to market. With its twin engines and complex drive train there is no doubt that cost of manufacture, cost of purchase and maintenance in operation would have been high. This born out in the high cost quoted in the proposal to Great Northern Paper Co.

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[17] *"The Lewiston Sun Journal"*, July 6, 1923
[18] **"***Railway Age"*, June 14, 1922, pg 1384

In the end the Lombard A-O-L (aka Old Twin/New Twin) would remain a very advanced one-off design. Its unique suspension was more advanced than that of the embryonic battle tanks of the era and presaged the slow evolution from the rigid WW1 era track systems to flexible and resilient suspension systems that would eventually allow rapid travel and stability over rough terrain. The A-O-L's unique duplex drive would not come to light again until the introduction of the massive twin engine Euclid TC-12 bulldozer in 1955. Opportunity lost? Perhaps, but it's still a good story of an innovative tractor design from a small Maine company that could of *"Knock*[ed]*'em cold."*[19]

LOMBARD TRACTOR AND TRUCK CORPORATION

S. L. G. KNOX
PRESIDENT
H. J. CHARLES
SECRETARY AND TREASURER

WATERVILLE, MAINE

342 MADISON AVE.
NEW YORK CITY

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ALL AGREEMENTS ARE CONTINGENT
UPON STRIKES, ACCIDENTS AND OTHER DELAY BEYOND OUR CONTROL

May 12, 1928

Great Northern Paper Co.,
Bangor, Maine.

Dear Sirs;

We hereby offer to build for
in accordance with the attac
sum of $48,900.00.
If six tractors are ordered a
$9~~5~~,000.00.
If three tractors are ordered
the price for the second lot
Changes in design after contr
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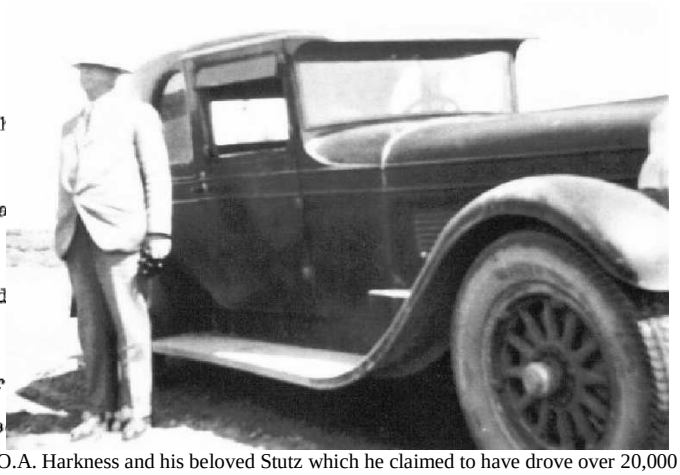

O.A. Harkness and his beloved Stutz which he claimed to have drove over 20,000 miles without any maintenance other than oil changes – quite a feat for the 1920's
Terence F. Harper Collection

Very truly yours,

Lombard Tractor and Truck Corporation,

S L S Knox

President.

[19] Desmond, Hugh, *"The Northern"*, Great Northern Paper Co., Spring, 1926