CAPSULED HISTORY OF RAILWELDING

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As often happens in the scientific world, great discoveries are sometimes accidents. The genius lies in recognizing the practical application for the mishap and developing it to the point of replication by others. It was no different when "welding" was discovered in 1877 by Professor Elihu Thomson at the Franklin Institute in Philadelphia, Pennsylvania. He "accidentally" fused two wires together while discharging current from a Leyden jar (an early form of capacitor, consisting of a glass jar lined inside and out with tinfoil). However, it took him nine more years to perfect resistance welding as a process. (22)

The Europeans were quick to enhance the welding process and in 1890 they introduced bare wire welding to the United States. This method prevailed from 1890 to 1920 as the electric-arc welding method. Then, in 1906, the French introduced oxyacetylene welding as a means of joining pipeline in the United States. It was used primarily for short lengths until 1911, when the Philadelphia Gas Company welded a 1-mile long pipe. This was the longest continuous pipeline to that date.

The science of welding continued to be refined over the next few years. In 1912 a United States Patent was issued for an electrode coated with a bonder of sodium silicate. This was the first electrode to produce pure weld metal, with no impurities left over from the welding apparatus embedded in the weld.

For those in the railroad business, 1916 heralded a milestone in the development of Continuous Welded Rail

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Railroads in North America were experiencing rapid growth and development during the last half of the nineteenth century. Out of a dire need to answer questions about improved materials, designs and procedures, the American Railway Engineering Association was born. From its inception on March 30, 1899, technical problems have been addressed via committee. The results of which often become part of the A.R.E.A. Manual For Railway Engineering.

The A.R.E.A. also nurtures a close relationship with the Engineering Division of the Association of American Railroads, which began in 1919, and has given to be mutually beneficial. (28)

"By American Railway Engineering Association definition, continuous welded rail (CWR) consists of sufficient lengths of conventional rail, welded together to form a length of 400 feet or longer. However, lengths in actual use vary from 1,170 to 1,475 feet in length. The most frequently used length of continuous welded rail is 1,440 feet." (1)

1916 was the year that the Aluminothermic (Thermite) Welding process was finally perfected in terms of being capable of producing a satisfactory rail weld. It became the standard for use on street-car lines and by 1936, 85% of all street rail welding was Thermite. Street rail companies used welding to eliminate joints for safer operation and reduce maintenance costs, as well as provide a smoother ride for the passengers. Following is a brief overview of the thermite process. This is in no way intended to be complete.

A Thermite weld is produced by igniting a mixture of iron oxide and aluminum powder in a crucible. The thermite reduction of iron oxide produces molten iron. By adding various ingredients (metals) to the powder mixture, variations of steel can be produced to match the parent metal. The temperature generated during the reduction process is approximately twice that of regular molten steel. (19)

Thermite welding can be used in two ways. In the first, only the heat from the slag produced in the reduction is used to melt the parent metal pieces together. (23)

In the second, metal created during the reduction reaction is deposited as weld metal between two work-pieces. It is this second process that is used for joint elimination welding of rail.

There are six basic steps common to all thermite butt welding. They are: (4)

- Space and maintain rail ends at a gap between 5/8" and 2 7/8", and align.
- Mount pre-cast molds on joints.
- Pack mixture of bentonite, foundry sand and water around mold.

With new welding techniques constantly being developed, there needed to be a method of codifying, assembling and distributing technical knowledge to others in the field. The United States Government commissioned Dr. Comfort Avery Adams to form an organization to accomplish this task. On January 3, 1919 Dr. Adams formed American Welding Society (AWS), in Philadelphia, Pennsylvania. The following March, (March 27, 1919) the Constitution of the AWS was drafted. The entire Staff consisted of Dr. Adams and Ms. Marguerite Kelly, who stayed with the Society in an administrative capacity until 1949. Their first official publication was not presented until 1921 and was titled "Standards for Testing Welds". From these modest beginnings rose today's Journal of the American Welding Society.

- Pre-heat rail ends to between 1,100 and 1,800 degrees F.
- Place Thermite mixture (iron oxide and aluminum) in crucible and ignite. A chemical reaction produces aluminum oxide plus iron.
- Remove molds when the weld has cooled sufficiently, and finish rail to a smooth surface.

During the period covering 1928 to 1932 the Germans were experimenting heavily with welding track on lines other than those in streets. The German State Railroads experimented with "express track" -- standard 30 meter long rails welded together into 60,120 and 300 meter lengths. At this time, all welded track in Europe involved only light wheel loads on small, soft rail, 97 lb/yd, although the Germans had a number of long welded rails on bridges and in tunnels.

Elsewhere in Europe, England was welding rails into 225' stretches. English-settled Australia also welded rails lengths of 225' as the standard. France was welding rails into 100 meter lengths to handle faster train speeds and heavier tonnage.

Improvements were able to be made in the welding industry around 1929 because of the advent of another of those "accidents". X- rays were introduced as a non-destructive testing procedure to detect flaws in weldments.

Another milestone was achieved in 1930 when a United States Patent was issued to Hobart and Devers for a gas-shielded-arc welding method. The first welding plant for new rail was built in Pittsburgh.

1933 heralded the first practical use of CWR (Thermite weld) on main line track in U.S.

The Delaware and Hudson Railroad, at their Albany, New York line, used a new type of Thermite weld that combined a pressure butt weld of the rail head, with a fusion weld of the base and web. They were able to combine 39' sections of rails into 2,700' rail lengths. This endeavor involved 318 welds in curved, double track (130 lb. medium manganese). Annual traffic over this line was 12,000,000 tons, at a maximum speed of 20 mph. Average wheel loads 26,800 lbs.

Until this time CWR had not been used in main line track because it was thought expansion and contraction problems were insurmountable. This was not a problem with street rail because it was laid in paved streets and held tightly in place. To compensate for this anticipated problem, an experimental expansion joint, allowing 1'10" of movement, was installed 180' from the end of each section.

Failure to control expansion and contraction in CWR can produce: (2)
1. Track buckling or sun kinks.
2. Irregular line and surface.
3. Slewing of cross ties.
4. Irregular gauge.
5. Pull-aparts or open joints.

In 1934 Professor Meier of Germany published a paper listing optimum principals for laying CWR to avoid the above problems. He cited that the major obstacle to overcome was obtaining proper rail stress. Failure to control expansion and contraction, and the resulting derailments, occur because rail is not laid at the proper temperature (stress). Several methods have been devised over the years to enable achieving optimal temperature. Some of these are:
1. Using rail heaters over the entire length of the string
2. Using a rail heater in combination with a rail vibrator
3. Using a rail vibrator alone
4. Using a rail puller car
5. Using hydraulic jacks
6. Using bumping cars
7. Using rail coolers

But back to the Delaware and Hudson; after measuring the movement in the experimental expansion joints, it was found that the expansion and contraction on the CWR line was only slightly more than that of standard 39' sections in an ordinary track configuration. Average laying temperature at Albany was 125 degrees F. The rail showed little or no movement, even after cold winters. All welded sections kept their alignment, even on curves, and no tie movement was detected.

Celebrating their success on their first try at Albany, New York, the Delaware and Hudson began work at another site in Mechanicsville, New York. This job included 254 thermite welds on 131 lb. rail, welding it into 2,000' lengths of CWR in tangent double track. Annual tonnage over this line was 3,000,000 tons with an average wheel load of 40,000lbs. Success again!

The third installation on the Delaware and Hudson was in Schenectady, New York. Due to a lack of room, they were not able to weld "on location" this time. Instead, rail was welded on top of flat cars in their Mohawk Yards (three miles from site) into 720' and 1480' lengths. A locomotive and derrick coupled onto the train and hauled the rail to the site. Even though the rail was not secured to the cars, the weight of the rail itself held it in place on the train, even when rounding 10 degree curves in track. The final result of the endeavor was CWR 11,787' long. 551 thermite welds and 70 electric flash welds were used to accomplish this task on 131lb. rail Annual traffic was 9,000,000 tons, freight only; wheel loads averaged 40,000 lbs.

Other railroads, noticing the D&H success began to follow suit. The Bessemer and Lake Erie Railroad installed one mile of single track with 269 thermite welds at River Valley, Pennsylvania. 1,800' was tangent track and 3,500' was curved track. Half was on level ground and the other half on a .65 grade. Annual traffic approximated 9,000,000 tons. Average wheel loads were 37,900 lbs. For the first time, both passenger and freight traffic utilized this CWR, traveling a maximum speeds of 55 and 35 mph respectively.

Maintenance of Way on jointed track was one of the highest expenditures the railroads were making 1936. According to American Railway Engineering Association (AREA), 45% of track maintenance was due to jointed track. CWR allowed for higher operating speeds and lower maintenance costs.

Some benefits of CWR to railroads are:
1) Eliminates joints, broken bars and bolt holes
2) Eliminates rail batter, increases rail life
3) Saves labor costs in
    a) Replacing worn rail with new.

b) Enables crew size reduction.
c) Reduces surfacing and time bearing cycles
4) Reduces mechanical wear of joint ties
5) Substitutes smaller, less expensive tie plate
6) More efficient track signal circuits
7) Reduces maintenance of rolling stock
8) Reduces slow orders, increase speeds
9) Reduces "rock and roll" derailments (27)

CWR was accepted by railway maintenance of way personnel because:
1) Low cost of Thermite repairs vs. joints
2) Speedy repairs in-track
3) Weld dependability

In 1936 rail length standards were increased in three major markets:
- U.S. increased from 30' to 39'
- England increased from 33' to 60'
- Germany increased from 90' to 100'

New CWR applications were being tried because of its promising future in reducing maintenance time and costs. A difficult place to repair track, and one where you definitely do not want a derailment, is in a tunnel. The Erie Railroad installed CWR in a one half mile tunnel at Otisville, New York early in 1936.

Also in that same year two CWR installations, 4,000' each, were laid in tunnels on the Northern Pacific Railway in Montana. These installations were unusual in that rails were first welded into 4,000' lengths on top of flat cars equipped with rollers. The rail train was then pulled into the tunnel and, with a locomotive attached to each end, it was broken in the center and pulled apart. The CWR settled to the roadbed for final anchoring.

More and more railroads began to lay CWR, aware of the promise offered by it. Twenty-two lengths of double track in an open cut on Brooklyn and Queens Transit Corporation, became part of New York City's subway system.

1937 marked three "firsts" in the United States. They were:
1) First use of electric flash butt welds in the United States. These were made by the Sperry Rail Service in Collaboration with General Electric. Flash welding was cost effective since it did not consume as much of the parent material during flashing. Metal was added to the work-piece from the wire used in the flashing process. (20)
2) The first Rail Train was used. It consisted of flat cars for 12'-780' strings.
3) The first thermite closure welds were made for a total of 31 miles. (3)

Several railroads tested welding sections less than one mile long, using a manual acetylene torch. Unfortunately these welds were of very poor quality and the process proved too expensive. The idea was scrapped as not being viable.

The oxyacetelyne, pressure butt, ground-mounted, weld was the predecessor to the modern welding production line. Using this technique, the Chicago Grand Trunk and Western welded 1/2 mile of track into CWR in 1939. (3)

Several break-throughs were invented in 1944 pertaining to methods of fastening CWR. They were: cut spikes, spring clips, and hook bolts. These combined to lower the per-weld cost and began to make CWR a viable alternative to jointed rail. Until this time new CWR was extremely expensive to lay and the railroads had a long time to wait for their return on investment. CWR was used in specialized situations, like tunnels, more readily than being used universally in main line track.

Still loyal to the commitment of improving laying of CWR, the German Federal Railway introduced CWR on concrete sleepers in 1952. (25)

By 1954 there were only 87 miles of CWR in U.S. But, it was quickly becoming standard practice to weld all new rail on many North American Railroads. Rewelding of secondhand rail was a cost effective way to recycle rail released by new rail programs or track abandonments, rather than scrapping it.

In 1955 a company named Matisa introduced the first modern CWR production line on the Santa Fe Railroad. These "plants" were mounted in railroad cars equipped with a Schlatter (Swiss) flash butt welder and internal shear; mechanized feed table, rail head and rail base grinders, remote control continuous reciprocating winch, back-up line, etc. As CWR rail trains added roller equipment and a 4-tier capacity, quarter-mile long strings became the standard.

A permanent railwelding plant was built in Atlanta in 1957, at the Inman Yard for the Southern Railroad. This plant consisted of several facilities for track assembly and welding. It produced CWR as well as rehabbed rail and pre-fabricated structures. It's initial function was to build track panels. The plant was upgraded regularly until 1980 when the final configuration consisted of a track panel plant, switch slab, cropping yard, welding plant, re-weld plant and a 78-foot rail facility. (5)

From 1959 to the end of 1981 there were 7,400 track miles of CWR laid on Southern property. In 1973 rehabbed rail was first used by cascading a total of 10.4 miles from a heavy-tonnage main line for reuse on a lighter tonnage line. No reprocessing was done to this rail, and any welding which needed to be done was of the field Thermite type, which was more costly than a plant weld. After 1973 the need for reclaimed rail welding plant was recognized (plant welds are cheaper and more durable).

Southern Railways committed to build a reweld/reprocess plant in 1979. Their plant used an electric-flash welding machine along with rail pushers, rail saws, rail polishers, base grinders and hydraulic presses. It was the first plant in the U. S. to accept rail in 1,440 foot lengths for reclamation.

Within five years (1961) Matisa built several additional plants and yearly production exceeded 1,000 miles of CWR. Electric flash butt was squeezing out gas welding, and these trainmounted plants made recycling second-hand rail more attractive.

Enter the Russians. *A compact, portable energy-saving electric flash butt welderhead was developed at the Paton Welding Institute in Kiev, USSR.* For the first time railroads had a method of direct field application of welds. No more huge plants resulted in a reduction of capital investment. Being able to take the welder to the site meant huge savings in rail transportation costs.

The Russian K-155 machine was mass-produced at Kakhovka Electric Welding Equipment Works specifically to be used for field welding. Kakhovka also manufactured a K-190 machine which welds rails by the continuous flash process, but is a permanent fixture at plants. (26)

By 1959 the Paton Institute had gone into commercial production of their welderhead. (6) Even today a typical flash welding machine consists of four major parts:

1. The machine bed, which is then attached to a fixed platen with clamps.
2. The movable platen with clamping assembly
3. A controller
4. The transformer. (21)

The Russians continued improving their welderheads, equipping the K-155 with two portable resistance welding heads, an electric motor, and motor-generator set, a device for pulling rail together and clamping rail in place for welding. The welderheads were raised and lowered with electric lifting jacks. This machine was mounted on a special platform which moved along the right-of-way. With this configuration the K-155 could weld up to 131 pound rail at a rate of ten welds per hour with a 14-man gang. (7) Between 1962 and 1963, there were 196,000 butt joints welded in Russia using K-155 and K-190 machines (1000 km of track). Tests proved the welds were consistently high quality.

Because of their commitment to the use of the "K" machines, 95% of long rails laid on Russian main lines were flash butt welded CWR by 1964. In that same year the Russians developed and improved the "K" machine (K-255) for use on extremely heavy rail types and allowed the continuous flash method to be used in the field.

Meanwhile, the French continued undaunted and by 1963 French Railways had made approximately one million welds in both high speed and service tracks. Most of these were thermite welds. In 1968 several Holland Officers were invited along with other North American Maintenance of Way officers to attend a demonstration of a Soviet welder on the French National Railways. Holland was so impressed with the success of the welderhead, they made plans to introduce the machine to the U.S. market.

Before going ahead with the full blown commitment, the American Association of Railroads subjected six Russian machine test welds to rolling-load, slow-bend and drop tests. These welds proved equal to the best welds produced by conventional flash butt welders at fixed plants.

Matisa, the company that built the first mobile rail welding plant in world, was bought in 1966 by the Holland Company, along with its personnel and assets. (24)

In 1969 the National Railway of Mexico purchased two sets-of SECMAFER machines for integral track renewal. These machines were specifically designed: for laying CWR. This group of machines does everything from re-grading ballast, to laying: concrete ties, rubber pads, tamping, and laying CWR at a projected rate of 1,1110 meters of track renewed in six hours of effective work, subject to traffic.

In 1970 Holland Company began making its mark in the CWR market. The Santa Fe had begun replacing jointed rail with CWR as early as 1952. However, problems cropped up in late 1970's and early 1980's. Main line tracks began showing signs of severe fatigue defects and needed immediate replacement. During this venture, the Santa Fe simply moved the worn rail to lower tonnage, lower speed lines. Numerous field welds were needed because of poor organization and planning before removing old rail and moving it to the new site and costs became prohibitive. As a time and money-saving solution, the Santa Fe planned to rehab the rail at the original site before moving it to the new site. To accomplish this, a Holland Company In-track welding crew welded rehabbed rail into 1,440 ft. strings, then loaded on to a rail train for transportation to the new site. (9)

Until 1971, the Santa Fe had maintained six separate plants for rail handling, cropping, storage, welding, loading and redistribution of rail. A feasibility study was done in 1971-72 relating to economies of system and it was decided there was entirely too much handling, and re-handling of the rail before arriving at its final destination. They decided to design one plant to handle all aspects of rehabbing CWR and locate it in Amarillo, TX.

They obtained the authority to construct the plant in 1972 at an estimated $5.2 million for their "Centralized Rail Welding Facility". In addition, four new rail trains were approved for a total of $1.7 million. The final approval for this $8 million capital expenditure was granted to the Santa Fe in November 1972

1972 was also a banner year for Holland Company. They introduced the Russian K-355A to North America. Holland designed and constructed a vehicle, power plant and other support equipment to adapt the Russian machine (welder head proper) to a mobile field-production line. Its first version rolled out in Spring 1972. The MobileWelder consisted of a K355-H (Holland modified) welder, power and control cabinets and hydraulic unit. The welderhead, designed like a large clamp, locks rail web between jaws. Once aligned, this assures perfect alignment. The Holland "Americanized" version of the Russian Welderhead afforded improved serviceability and ease of parts replacement. Unlike its parent, it could also be adapted to weld various types of rail by changing the program. (10)

This welder became a boon to the railroad industry. Its energy saving, continuous flash process, required only three minutes to complete a weld on 136 lb/yd. rail. The unique disposition of the welding transformer allowed for a decrease in short circuit resistance of the welder. As an in-track vehicle, it was designed to produce twelve welds per hour. However, the biggest problem faced by the crews was finding uninterrupted time on track.

Mounted on a rail vehicle, utilizing one head, or two in tandem, the MobileWelder could make 10,000-12,000 welds per year on a single shift, or 40 miles of CWR, with ideal weather and track conditions. The quality of the weld could be monitored on the welder itself by means of a recorder used to detect any machine malfunction. Also the weld quality could be checked on the weld zone proper for joint geometry and weld soundness using conventional testing methods.

Thousands of welds were made between 1972 and 1975 utilizing this new technology. Some of the larger contracts were as follows:

1972 to 1974
Atchison, Topeka & Santa Fe 16,000 welds
1974
Belt Railway of Chicago 3,000 welds
1975
Belt Railway of Chicago 2,000 welds
Chicago & Illinois Midland 4,000 welds
AMAX 8,000 welds

While the North Americans were making great headway, the Europeans had not lagged behind.

At the end of 1968, there were 3,782 miles of CWR installed on British Railways. (570,000 flash-butt welds and 133,000 termite). By 1983, this had increased to 11,000 miles of CWR, or about 50% of all BR track, with 1,850,000 Flash Butt and 900,000 thermite welds. Since 1968 axle loads increased from 22 tons to 27.5 tons and speeds from 110 kph to 200 kph. (14)

In 1973 there were 47,000 miles of welded rail in Germany. Passenger trains operating at 100 mph up to 125 mph were foreseeable in the near future. (11)

Germans were renewing a maximum of 7,000 feet of track in one day. Rail was received in 98-foot lengths from steel mills, then welded into 400' lengths at a centralized plant. After placing it in-track, field crews welded the 400' lengths together using Thermite Welds.

France began running test passenger trains in excess of 180 mph. Freight trains were held at 50 mph, with excep¬tions up to 70 mph. France used welded rail in relatively straight track only. They were not laying CWR around curves sharper than 3 degrees 30 minutes because of fastening and excessive wear problems.

In 1974 Plasser bought its first K¬355A from Russia. By 1977 they introduced a Mobile Unit for In-track welding in France. This unit was first used to construct a high-speed railway from Paris to Lyons (trains traveled up to 240 mph).

The Russians continued to improve their invention. By 1975 over 400 in-track Portable Electric Flash Butt Welders were in service. They were uniquely suited for in-track work, but could be adapted to perform in a permanent set-up. Now closure welds could also be made. (12)

Some of the newly introduced improvements included:
1. "impulse fusion" which reduces welding time and rail consumption by one third and,
2. a built-in shear for removal of upset, which reduced crew finishing time.

The applications for portable welderheads were increasing exponentially. The uses included:

- Existing and new track
- Standard and panel track construction
- Opposite or alternate joints
- Main and branch lines
- Tangent and curved track
- Yards, sidings, passing tracks
- Transit systems, mines and industrial tracks
- New rail and second hand, with or without cropping
- Standard, curvemaster and heat treated rail
- CWR from one insulated joint to next
- CWR between road crossings and through towns
- Closure welds, rail repairs and insulated joint inserts.

These MobileWelders proved, time and again, to have the capacity to handle all jobs commonly done by inplant and thermite processes. One machine handled all the rail processing at one time.

In 1979 Holland Company introduced the first road/rail MobileWelder Series 200. This truck was not rail bound and could be moved from site to site via the highway system. When it arrived at the site, the wheels were changed to allow access to the track.

At this same time there were now over forty permanent rail welding plants in North America. Due to the high cost of handling and moving rail from site to site, Holland pioneered the Mini-plant, or Porta-Plant as they called it, using an in-track welder head in a semi-permanent set-up. They also produced plants mounted on pallets for easy transport and deployment.

British Rail's Advanced Passenger Train began operation in 1982 between Glasgow and London on the West Coast Mainline. It reached speeds up to 150 mph on 113 Lb. CWR, using concrete ties and Pandrol clips. BR's High Speed Trains are diesel powered and operate between all major population centers at sustained speeds of 125 mph. The original track, constructed 130 years ago, has been renewed. The old bullhead rail which is laid in cast iron chairs, and the flat-bottom rail laid on base plates, was replaced with 113 CWR, flat-bottom rail with normal grade steel, on concrete sleepers with Pandrol clips.

1983 signaled a pilot project between the AT&SF and Holland to set up a K355H welderhead in a porta-plant, at a 15 mile relay on double track in the Mojave Desert of California. They planned to have this plant recondition second hand rail immediately behind system steel gang (eliminating all shorts, scrap, joints and rail defects). Reconditioned strings would be in 1,440 foot lengths, saw cut and with 2-holes drilled for easy loading on a pick-up train.

The Burlington Northern had recognized the advantages of CWR and in 1985, purchased two 200 Series MobileWelders from Holland, to be used for full time field welding at various sites. In 1987 they adopted a CWR policy of rehabbing second-hand main line rail, exclusively utilizing thermite welds, even though these have several drawbacks:
1) Cast structure makes them the weakest link in CWR strength,
2) Collar protrusions on rail base do not allow proper seating of tie plate area.
3) If second hand rail containing existing thermite welds could not be utilized because of poor condition of weld, then rail was scrapped, otherwise, the weld was left intact and incorporated into rehabbed rail. (15)

1987 and 1988 marked the first years that the Union Pacific began rehabbing rail. Rail was welded at the destination site with thermite welds, although they were considering using a flash butt welder.

In 1989 studies proved that electric flash butt welds lasted longer, especially in heavy tonnage situations. Utilizing jacking systems may make flash butt the weld of choice over thermite, because this allows the track to be welded at the proper laying temperature by stretching the rail. To facilitate this solution, Holland Company introduced the SuperPuller. When used in conjunction with the electric flash butt welderhead, it improves productivity by up to fifteen minutes per repair plug, therefore, reducing track time. "The SuperPuller closes the pre-weld rail gap by pulling the rail so that the rail stress will equate to the proper rail laying temperature at the weld's completion." (16) 'The Puller remains behind MobileWelder, holding the closure weld in a stress-free state for 10 to 15 minutes, until the rail temperature is below 700 degrees.

At this same time, Plasser American Corp. introduced the K-355 APT Super Jack Flash Butt Welding Machine which was a railbound vehicle. It featured both a chart recorder and an internal shear. The jack and welding head were fully synchronized and it could close a rail gap up to 7" at a rate of up to five closure welds per hour.

In 1990 the Burlington Northern began using Chemetron Railway Products' "train-to-train" concept. Here rail is re-welded to rehab rail for salvage operations. Worn rail is recovered from various points on the line and loaded on a rail train. It is then brought to the Leamington, Ontario plant, on a siding, welded into good strings and loaded directly to another rail train for transport and relaying in low tonnage lines, branch lines, secondary mains.

Throughout the 1990's mobile flash-butt welding applications continued to expand. During the decade of 1990, mobile flash-butt welding was introduced into rail renewal operations on several U.S. Class One Railways. This enabled a rail renewal crew to offer a complete finished product without additional need for track occupancy at a later date to complete the welding process with thermite welds. This application quickly spread to all major railways in North America.

Beginning in 2002, Holland began to develop two new railwelding technologies that would improve productivity and reduce the cost of field installations of flash-butt rail welds in closure welding applications. The first was the introduction of a flash-butt weld, (LCW - Low Consumption Weld) that consumed ¾ of an inch of rail as opposed to 1-1/2 to 2 inches. The second was the introduction of the Holland Puller-Lite. A 160-Ton Super Puller that was 50% smaller and lighter than previous models. Both of these technologies combined would further reduce the cost of installing flash-butt closure welds. This led to the growth of in-track joint elimination or repair welding with flash-butt welds only. Because of the productivity increases and reduced labor associated with flash-butt repair welding, now in many applications, the higher quality flash-butt weld could be installed for less than the alternative thermite weld. (29)

This is by no means where improvements in welding rail into CWR stops. New processes are constantly under investigation for producing in-track and plant welds. New processes include:

1) Electron Beam Welding which takes place by the impingement of a focused beam of high-velocity electrons with the work-piece. The beam is always generated in a high vacuum, but the work-piece can be at atmospheric pressure, low vacuum or high vacuum. One unique characteristic of this process is the high-energy density of the beam which permits deep penetration and a small weld width. (17)

2) Laser Beam Welding is produced by focusing a high intensity light beam onto the parts to be joined. Like electron beams, they provide a high-energy density heat source and can make narrow welds. The major limitation of lasers is that the maximum penetration is about.8 inch at a power of 24 KW and 50 in/min travel speed.

Obviously, Continuous Welded Rail is here to stay. Because it initially costs more to install than bolted track, it maybe limited to high-tonnage main lines. (18) But demands for fuel efficiency, lower maintenance costs, higher travel speeds and competing with over-the-road carriers, has made it a mainstay in railroads world wide. Taking the welder to the site seems to be the most viable option today. Perhaps, with the new open communication between the U.S.S.R. and other nations, even more improvements can be made on welding equipment.

Be sure to check out http://www.hollandco.com for new flash-butt welding technologies.

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