This is the written testimony of Fred Gurney, PhD, of MAGLEV, Inc. for the hearing before the House Transportation Committee at Carnegie Mellon University. The hearing date is Friday, November 6, 2009.

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Testimony of F. J. Gurney before the

Pennsylvania House Transportation Committee

November 6, 2009

Democratic Chairman Joseph Markosek, Republican Richard Geist, members of the Committee, I am delighted to have the opportunity to testify this morning before this commission. I particularly want to focus on high-speed maglev technology and initiating true high-speed intercity passenger rail service and its potential economic impact. I am the President and CEO of MAGLEV, Inc., a company that is vitally concerned with the future developments in both transportation and job creation and is the private partner, with PENNDOT, in the Pennsylvania High-Speed Maglev Project. This is a high-speed intercity transportation project with the initial deployment in southwestern Pennsylvania. The initial project will be a 54-mile long alignment beginning at the Pittsburgh International Airport and link to downtown Pittsburgh and then continue on to Monroeville/Penn Hills and then on to the city of Greensburg.

There is a new emphasis on high-speed passenger rail in the United States. We applaud that emphasis and specifically its high-speed focus. Presently the Stimulus Bill is dedicating a significant portion of the ARRA funding available for high-speed rail toward conventional dual use rail traffic to remove obstacles that limit passenger service. But without construction of dedicated passenger-only grade-separated track we will still be limited to speeds of 79 to 110 mph. We believe that a transition to true high-speed service is essential to demonstrate to the American public that high-speed passenger service offers significant benefits to the traveler. I believe that high-speed maglev is the ideal technology to do this demonstration.

High-speed maglev offers an unprecedented opportunity to establish long-term, high-speed intercity rail service and it can do so without the need for an annual operating subsidy. Not only am I strongly advocating high-speed maglev, I am also a very strong advocate of starting the initial deployment in the Pittsburgh area. Pittsburgh is strategically located at the core of an ultimate multi-state, intercity operation, is located within a five hundred mile radius of one-half the population of the United States, or directly in the heart of the five-hundred mile range, referred to by FRA as the "sweet spot" or optimum range for applying the technology. Deployment in the Pittsburgh area will demonstrate the ability of the technology to perform in a challenging terrain that has a full four-season climate.

It is truly high-speed, cruising at speeds up to 310 mph; ----- it is green technology; ----- it is energy efficient transportation; ----- it offers substantial timesavings and quality of life enhancements to travelers and ----- it is selfsustainable once built. With a minimal amount of required maintenance, its basic infrastructure can reasonably be projected to an 80-year life cycle.

The Pennsylvania High-Speed Maglev Project utilizes a fully developed, high-speed train system that has been developed and continually improved by Transrapid International for over thirty years at its facilities in Germany. It has been operational in Shanghai, China since April 2004 where its on-time performance is 99.9% within one minute of schedule. It is the high-speed system most frequently referred to by President Obama and Vice President Biden.

The proposed 54-mile long project will provide extremely reliable service while reducing travel times by as much as thirty minutes per segment between stations during rush hours and other congested periods and in all weather conditions. It will reduce highway congestion and the related emission of NOX fumes in an area identified by the EPA as having a high level of particulates. High-speed maglev will demonstrate the ability to enter easily into the heart of a compact and densely populated urban area. It will provide immediate and direct access to the airport ticket counter area via escalators and elevators. It will provide full, direct intermodal access between buses, auto, and light rail systems and enter the heart of a major city with an unprecedented low-impact on existing structures (less than four per mile).

MAGLEV, Inc. is pleased to report that the project's Final Environmental Impact Statement is ready to be published in the Federal Register. The document is currently on the desk of the FRA Administrator awaiting signature. The Pennsylvania Project is the only high-speed maglev project to have completed its environmental impact statement.

In May 2009, Transrapid International, the developer of the technology, completed certification of the ninth version (TR-09) of this advanced vehicle design that incorporates the most recent refinements in the system technology. MAGLEV, Inc. has maintained a very close working relationship with Transrapid International and is currently in the process of implementing a technology transfer agreement to assure that the entire vehicle and system controls are manufactured in the United States, as well as the guideway.

MAGLEV, Inc.'s many years of working with the Transrapid International system has enabled it to develop a detailed cost analysis, which has been verified by independent cost studies.

High-speed maglev requires a grade-separated guideway. In Pittsburgh, it will be entirely elevated except at the stations. Capital costs of high-speed maglev are competitive to those of grade separated steel-wheel-on rail systems and to four-lane super-highways. However, because maglev transportation has no moving parts and is elevated above the guideway during operation, it has almost no wear and virtually no need for alignment maintenance. This allows it to operate nearly twenty-four hours per day and lowers its operation and maintenance costs to approximately one-half those of a steel-wheel system.

Sustainability

Under TEA-21 and SAFETEA-LU, the federal High-Speed Maglev Deployment Program required all maglev projects to be financially self-sustaining following construction. As opposed to steel-wheel-on-rail systems, high-speed maglev requires no routine or recurring track adjustment (nor would it be operationally acceptable) to maintain high-speed maglev service. Steel-wheel-on-rail operations require intensive track maintenance to sustain proper gauge, elevation, cross level and other track standards that become more stringent with increased operating speeds. Maintaining these stringent standards is further compromised when the track is shared with heavy freight operations, a phenomenon that applies strong geometric forces to the rails and causes a shift in their alignment, necessitating constant correction.

The absence of a similar maintenance requirement for high-speed maglev is based on the fact that there is no unintended shift or movement in the guideway. The end result is that no annual operations and/or maintenance subsidy would be required to support the operation of the high-speed maglev system. This is unprecedented for any transportation system worldwide. The fact that high-speed maglev has no moving parts and does not touch the guideway during operation results in very low O&M costs and enables the project to be self-sustaining.

Precision Fabrication

Construction of high-speed maglev initiates an important associated economic spin-off technology that offers additional long-term job creation. The precision manufacturing of large steel structures, such as required in the fabrication of high-speed maglev guideway, is vital to the performance and operation of the high-speed system. Guideway beams must be within five millimeters of deviation throughout a 204 foot-long beam, depending on the specific location on the guideway beam, to produce a product acceptable for high-speed maglev operations.

Heretofore, such precise fabrication of large welded components has generally been considered a liability because of the difficulty in controlling the welding process. However, MAGLEV, Inc is developing and demonstrating a fabrication methodology that not only addresses fabrication issues, but does so at reduced costs. These newly developed precision fabricating methods, with cost-reduction and quality benefits, will create new opportunities for the steel industry, shipbuilding, highway bridge and access-ramp construction and any other large-scale metal fabrication application.

When applied to bridge component construction or rejuvenation, the benefits of precision fabrication will manifest themselves in the lower costs in direct fabrication and in reduced rework. This will make the tax funds dedicated to bridge construction go further. If we consider that the National Bridge Inventory statistics that more than 30 percent of all bridges in the United States are deficient in some way it is easy to see that even small cost reductions in fabrication can make a significant impact on projects funded by tax dollars. Our nation's fabrication industry will produce product less expensively with higher quality and product that is faster to market.

Job Stimulation from Building High-Speed Maglev

Building high-speed maglev will be a long-term economic generator for our nation. The raw materials, fabrication expertise and construction requirements to build high-speed maglev by themselves would provide an economic stimulus of significant magnitude.

The system will use American-made steel guideway. At a prior T&I Railroad Sub-committee hearing, a former US Steel executive was asked what impact high-speed maglev would have on the nation's steel industry. He said that if this nation builds only 200 miles of high-speed maglev per year, it would require the total output of the Gary, Indiana plate mill just to provide the steel for maglev. It would require a 12.5% increase in the demand on the nation's total steel plate production. Pennsylvania Transportation Secretary Al Biehler has identified job creation potential from transportation projects of 30,000 jobs of all types for every $1 billion of transportation construction funds.

Raw Material Usage

The following list shows some of the raw material usage associated with the construction of the 54-mile long Pennsylvania Project:

- 330,000 tons of plate steel
- 140,000 tons of steel reinforcing bar
- 41,000 tons of magnetic steel laminates
- 1,400 miles of aluminum conducting wire of ¾ in diameter
- 712,000 cubic yards of concrete

The vehicles will also require sheet aluminum, copper, steel and various non-metallics in the body structure.

The transportation power, signal, and communication and control system will require power transformers, computers and control electronics. The stations and support buildings themselves will require all the assorted materials that compose modern buildings.

Linking Cities through Travel Time Reduction

Another concern impacting the growth of commerce in our region and in the United States is the increasing travel delays associated with congestion on the nation's highways and at its airports. Almost every day reports of road rage, and more increasingly, air rage are broadcast to us over the media emphasizing the growing frustration of travelers. Statistics on lost productivity from travel delays show the growth of the problem. The cities and regions that provide a mechanism for capturing that lost time will place themselves in a significant position to reap the tremendous economic benefits that will result.

High-speed maglev offers a means and opportunity to capture some of this lost travel time. As an example, the current highway travel time between downtown Philadelphia and downtown Pittsburgh requires about six hours. Traveling that distance by air with consideration of time delays at each airport makes that travel time average three hours. Since all maglev stations will be off line, traveling the same distance by high-speed maglev on an express run bypassing intermediate locations would require slightly less than two hours, even with stops at intermediate locations.

High-speed maglev offers an excellent return on public investment with the creation of 60,000 direct and indirect jobs for construction of the initial segment. It offers the ability to create an entirely new industry in Pennsylvania while delivering the most advanced intercity ground transportation system in the world. MAGLEV, Inc. has developed a precision fabricating system with computer-integrated technologies that were designed and developed to drive down the cost of building the system's guideway. This advanced technology is also applicable to bridge construction, ship building and other large-scale metal fabricating uses.

The Obama-Biden Administration's emphasis on high-speed passenger rail represents a major policy change for transportation in the United States. However, this transformation cannot take place overnight. We recognize the need for incremental improvement in rail passenger service throughout the United States, primarily through improvements in service provided by Amtrak in rights-of-way shared with freight service. But we must also begin to deploy true high-speed service were it will ultimately be part of a broader national network of high-speed service.

The Pennsylvania High-Speed Maglev Project is the only high-speed project that is ready for construction in the near term. We have all seen President Obama and Vice-President Biden repeatedly refer to the high-speed maglev train in Shanghai, China. Well, this is that same train and it is ready to be built right here in the U.S. and, if funded, the first section can be completed within the next 2 1/2 years.

Based on the information presented in this testimony, the project requests the support of the legislature in bringing the project to reality and to capture the economic benefits associated with it. This project presents an opportunity to elevate the state to the premier position it has held in national leadership in transportation technology and it also offers the potential of a whole new industry within the state for the transportation technology and the manufacturing processes associated with it.

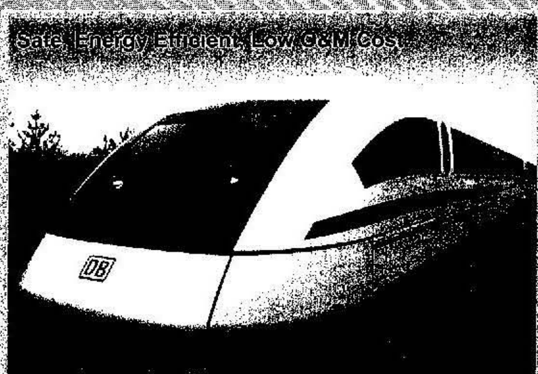
The Pennsylvania Project - High-Speed Maglev

- 54 Mile Project
- 250 MPH Top Speed
- Designed for Three to Five Section Vehicles
- Capital Cost Comparable to Highway or Light Rail
- Significantly Reduced Operating & Maintenance Cost
- Safe, Energy Efficient, Alternate Energy Potential
- Environmentally Friendly, No Vehicle Emissions
- Proven Commercially Deployed Technology

- East/West Connectivity – Airport Link
- Five Intermodal Stations
- 8 Minutes from Airport Enlow Road to Downtown
- 11 Minutes Airport Terminal to Downtown
- Direct Connection at Airport Terminal
- Connection to Downtown LRT and Busways
- Approximate 8.5 - 10 Minute Operating Schedule

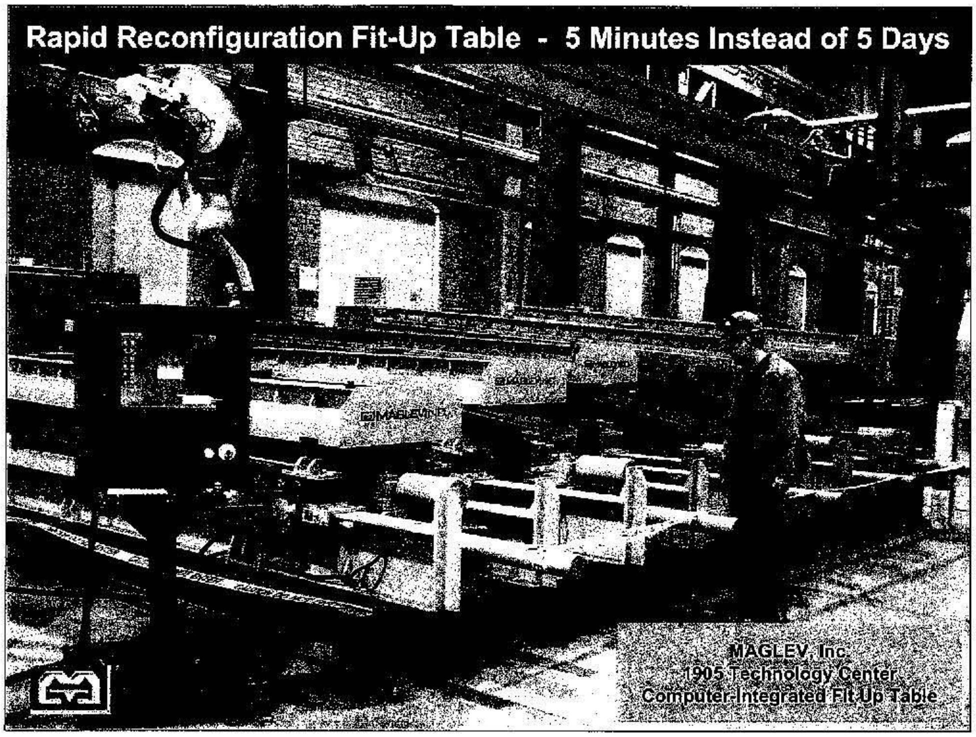
Conceptual Rendering of Downtown Station Between U S Steel Building & Mellon Arena – Above Cross-town Boulevard

Transrapid Technology



The Project

Transrapid in Shanghai



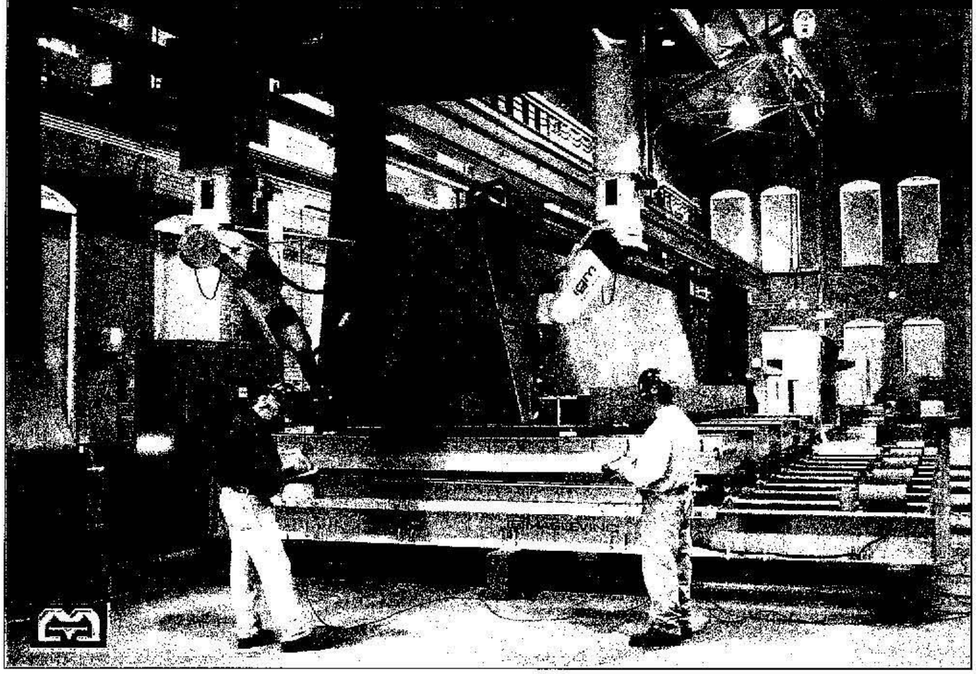
Time lost in reconfiguring a fabrication process from one geometrically shaped component to another is one of the most costly aspects of fabrication of unique geometrically shaped components. For complex curved shapes produced to precise dimensions, the reconfiguration time can be as long as a week.

Securing cost reduction in fabrication of a series of uniquely dimensioned components demands flexible and agile fabrication processes. Achievement of these criteria is part of a totally integrated process developed as part of MAGLEV, Inc.'s precision fabrication process for large steel structures. Illustrated above is a five-unit assembly of arms with each arm being independently positioned by a computer. Operating all arms synchronously, positions the top of the arms to develop a flexible fabrication table to allow production of any variation of complex curved shapes.

Integral with the ability to make rapid fabrication table changes is the requirement for exact mathematical descriptions of the product to be fabricated. Mathematical criteria describing design requirements are used to establish a computer data base. Digitized data are utilized to position multiple arms of a total fabrication table.

Incorporation of this computer driven fabrication table into a total precision fabrication process allows table changes to be accomplished in a few minutes rather than days as required in conventional processes. This greatly reduces the cost of fabrication of large steel structures while simultaneously assuring highest quality of dimensional control.

Robot Synchronization with a Gantry System and Automated Fit Up Table

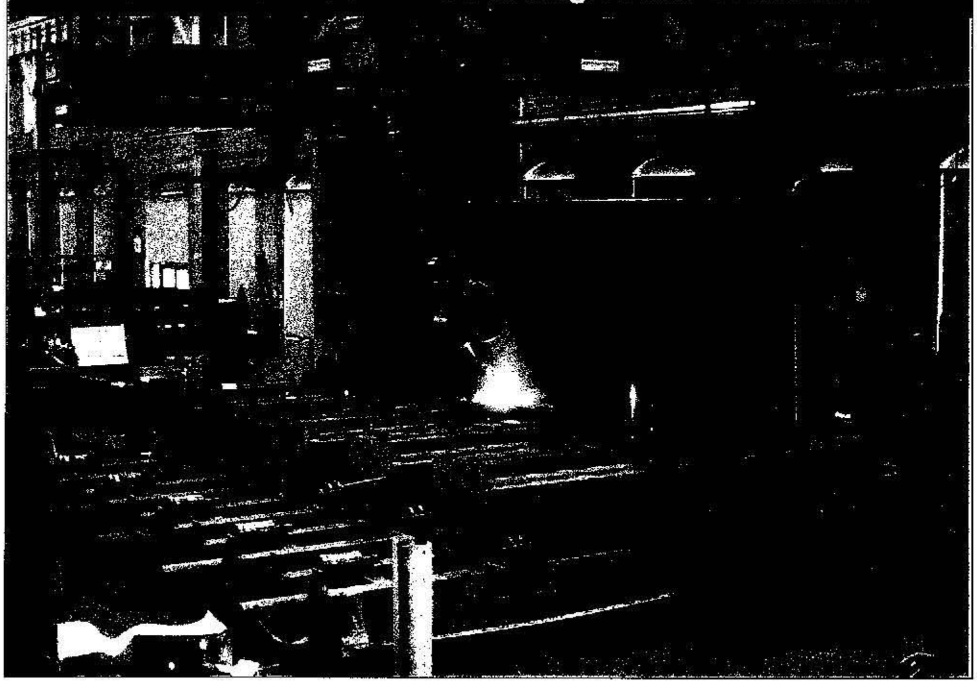


Pilot plant demonstration of a fully automated process for fabrication of high-speed maglev guiderails has been established at the MAGLEV, Inc. facilities in McKeesport, Pennsylvania. The facility allows high precision fabrication of very large and very long structural steel components that incorporate compound curves as well as twist. The facility demonstrates significantly improved time-to-market capability, improved dimensional control, and cost reductions of up to 20 percent. The system allows fabrication of one-of-a-kind components to be performed almost as simply a long production runs. This pilot plant facility demonstrates a greatly improved competitiveness of the steel fabrication industry in the United States.

The pilot plant features a side beam gantry with two robots and an automated fit-up table. The gantry system itself has three-axes of motion that includes 35 meters (approximately 115 feet) of movement in the longitudinal direction, 3 meters (approximately 10 feet) movement in the cross depth direction and 1.5 meters (approximately 5 feet) of movement in the vertical or height direction. The longitudinal capability of the gantry can be augmented to allow fabrication of components of up to 65 meters in length. Additional robots can also be added.

Each of the dual robots has six-axes of motion and is capable of being programmed off-line. The robots will also be capable of being operated back-to-back so that synchronous welding processes can occur. Synchronous welding enhances dimensional control.

Integrated into the process is a computer controlled and fully automated precision fit-up table. The table allows precise dimensional control to be achieved in large compound curved structures that also include twist. Set-up can be achieved in minutes rather than days required for conventional fabrication shops.



During 1999, the Federal Highway Administration and a panel of bridge fabrication technology experts from across the United States conducted a major review of international bridge fabrication technology through visits to leading bridge fabricators in Europe and Asia. A symposium report in 2001 summarized the findings from that review. Those findings included 1) bridge fabrication in the U.S. could be accomplished more efficiently and economically if automation and robots were utilized, 2) elimination of submerged arc welding and its required flux handling systems in favor of automation-friendly GMAW or MIG/MAG welding process should be considered in the U.S., and 3) use of a single 3D CAD model as the sole source of information on detailing, shop drawing information, CNC drilling and cutting instruction, automated inspection and virtual assembly would promote efficiencies in U.S. manufacturing.

The three items mentioned above were already mostly in place at MAGLEV, Inc.'s facilities in McKeesport, Pennsylvania. Those capabilities included a 115 ft. long dual robot gantry GMAW welding system and a shorter but expandable computer automated fit-up table both of which were in process of being integrated directly with a 3D CAD modeling process. Subsequently, PENNDOT funded MAGLEV, Inc. to use its capabilities to demonstrate fabrication of a full cross-section but abbreviated length I-beam typical of those used by PENNDOT.

The illustration above shows a full cross-section beam, 6 ft. 9 in. high, but only 23 ft. long, that was fabricated on this program. While the beam design utilized in this program was for a straight section, the fit-up table was capable of developing compound curves including super elevation directly from the 3D CAD model and could be accomplished very accurately and very quickly. A single set up allowed horizontal, vertical and overhead welds to be performed.

The program illustrated 1) a 3D CAD model integrated with computer automated fabrication equipment can yield enhanced fabrication efficiencies, 2) high dimensional control and quick set up times can be achieved with computer integrated processes, 3) very high quality out-of-position welds were readily achieved with gantry robotic equipment, and 4) computerized fabrication equipment was directly applicable to the bridge and highway market.

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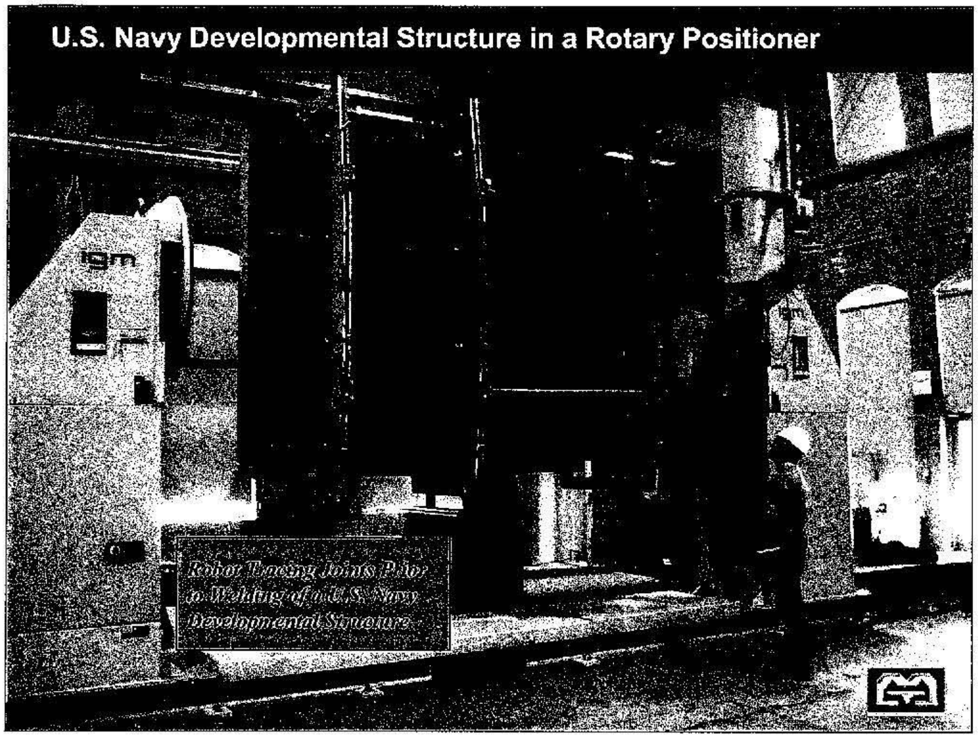


A developmental structure for the U.S. Navy is mounted between rotary positioners and being rotated. The illustration is of the topside of the structure and shows the fixturing and hold-down mechanism for the structure. The ability to rotate large structures offers advantages by promoting both ease of welding and weldment quality by allowing down hand welds to be performed instead of the more difficult vertical welds. Use of rotary positioners such as that shown in this illustration increases the versatility of welding operations for large complex structures.

4th Semester Program at MAGLEV, Inc.'s 'Teaching Factory"

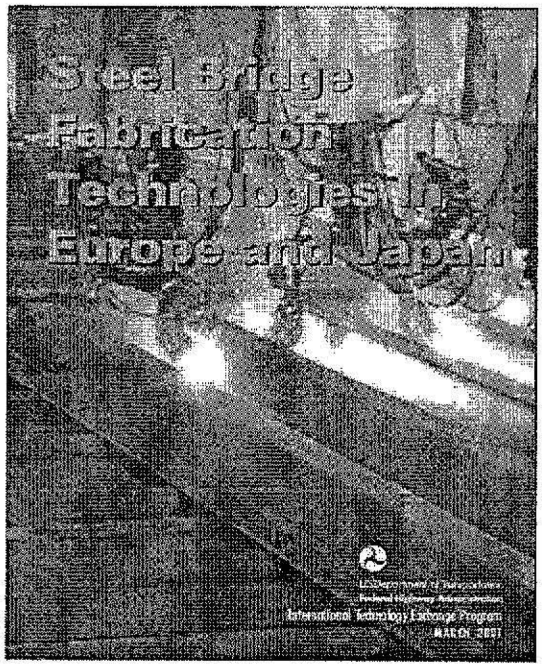
MAGLEV, Inc.'s Precision Fabrication Technology Education and Training program is focused on computer integrated fabrication processes. Advanced processing equipment in MAGLEV, Inc.'s facility allows focus on both precision and automation while at the same time emphasizing agility and flexibility. The facility includes a totally integrated fabrication system that incorporates a gantry system with two IGM welding robots and an automated fit up table. The equipment also includes two stand alone Fanuc robot cells that can be integrated into fabrication processes as needed.

Additionally, three ABB robotic welding cells are available that are specifically dedicated to research and training. These cells, one of which is shown in the illustration above, were designed by MAGLEV, Inc. to be transportable by flatbed trailer to locations in industry and training facilities as needed. These cells are an integral part of the MAGLEV, Inc. Precision Fabrication Training program for Associate Degree students and they will also be used for incumbent worker training as well.

The DOT and FHA Toured Europe and Asia for Best Practices in 2001

The work being performed at MAGLEV, Inc. is addressing issues identified on this tour.

The purpose of the scanning tour was to conduct a broad overview of newly developed manufacturing techniques that are in use abroad for steel bridge fabrication and erection, as there is a need to further modernize structural steel fabrication facilities in the United States.



The focus of the trip was on the role that steel production, design, innovation, and fabrication have in modern steel fabrication facilities in Japan, Italy, Germany, and the United Kingdom

> *Following the tour there was a workshop that produced an overview of things learned from the trip. From the Overview of the Symposium and Workshops Established after the 2001 "Scanning Tour" of Asian and European facilities implications were established. Implications for changes to U.S. practice, if these advances were to be deployed here, include the following:*
>
> > *•Elimination of submerged-arc welding (and required flux handling systems) in favor of automation-friendly GMAW or MIG/MAG welding processes, and*
> >
> > *•Use (and long-term archival) of a single 3D CAD model as the sole source of information on detailing, shop drawing information, CNC drilling*

and cutting instruction, automated inspection and virtual assembly (geometry verification).

The effort was "Looking for Optimal Factory Automation Balanced Against Demand, Capital Investment and Efficiency". The team identified top priority implementation topics in six Areas of Focus and several Lower Priority Items. Several of these were to:

- Develop a workshop on gas-shielded welding and new methods of welding for shop and field fabrication for fabricators and owners
- Work with FHWA and State Departments of Transportation (DOT's), with AWS Bridge Code support, to gain acceptance for gas-shielded welding as a preapproved welding process.

Review of the report shows that Asian and European bridge builders utilize a much higher percentage of GMAW (Gas Metal Arc Welding) and automated processes vs. SAW (Submerged Arc Welding) welding. MAGLEV, Inc. is utilizing GMAW welding equipment similar to that in use in Germany.

	% SAW	**% GMAW**
Japan	10	90
Italy	70	30
Germany	15	85
UK	50	50
Average	**36%**	**64%**

HR ONE COMPANY I *Many Solutions sm*

July 12, 2007

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RECEIVED JUL 16 2007

RE: Applicability of Automated Welding Technology to Address Local and Interstate Highway Bridge Infrastructure Needs

Dear Mr. Gurney:

We are excited to offer our thoughts to you regarding the above subject. Based on our recent visit and tour, we see an appropriate, time-sensitive use of your developing technology in the highway bridge industry, and possibly the railroad bridge industry.

Currently, many 'bread and butter' type highway bridges are in a deteriorated condition and in need of rehabilitation or replacement. Many of these bridges have geometry constraints that make a steel bridge the ideal solution, but current fabrication processes often yield steel bridges more expensive than their concrete counterparts. What makes the steel bridge solution attractive is the ability to design steel bridges thinner than concrete bridges, thus avoiding the need to raise approaches in order to maintain or increase clearances. The introduction of a more cost-effective and efficient steel bridge beam fabrication process or processes, such as your developing automated welding technology, could make the steel bridge solution a more economical, all around better solution than utilizing concrete bridge beams.

We think your technology is directly applicable to the production of welded steel tub girders currently used on highway bridges nationwide. Although some transportation agencies do not currently favor steel tub girders due to their perceived higher costs over steel I-girder bridges, states such as Florida, Connecticut and Texas, regularly use tub girder type structures.

Specifically, the introduction of your automated welding technology to the existing fabrication processes used nationwide to produce steel highway bridge girders could provide a dual benefit to the traveling, tax-paying public, more economical *and* more aesthetic bridges. This technology could position the steel bridge fabrication industry to better compete in the US with concrete products, and internationally with both steel and concrete products. However, should US fabricators not embrace this or similar enhancements to their fabrication processes, the US steel bridge fabrication industry may soon find themselves further behind their European and Far Eastern competitors, as indicated in the recent FHWA-sponsored scanning tour on the subject of steel bridge fabrication. This tour noted that the Europeans, Japanese and others are already using more advanced automated welding and automated weld inspection techniques than US fabricators, but not as advanced as your process could soon be.

We encourage you to continue your development efforts, and recommend that you strive to bring your advancing technology to the US steel bridge fabrication industry, sooner than later. Should you or anyone else wish to discuss this recommendation further, please do not hesitate to contact either of us.

Sincerely yours,

HDR ENGINEERING, INC.

Ralph W. Gilbert, P.E., Senior Vice-P ent
Senior Vice-President

✓ John M. Yadlosky, P.E.
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Welding Methods

Many different weld methods are used in the U.S. bridge, highway and heavy equipment fabrication industry. Today the U.S. bridge industry is widely using submerged arc welding (SAW), but heavy equipment manufacturers are mostly utilizing metal inert gas (MIG) welding technology. In Europe and Japan the bridge industry is largely using MIG (GMAW) welding.

Both processes require that the molten and cooling weld metal be protected from oxidation and gas contamination. SAW uses a slag process to provide that protection while MIG uses a protective gas to provide the protection. This protection is required because the atmosphere has hydrogen, nitrogen, oxygen and other gases that will cause weld defects if allowed to get into the weld pool.

Submerged Arc Welding (SAW)

SAW is a common arc welding process. Originally developed by the Linde-Union Carbide Company, it requires a continuously fed consumable solid or tubular (flux cored) electrode. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular, fusible flux consisting of lime, silica, manganese oxide, calcium fluoride and other compounds. When molten, the flux becomes conductive and provides a current path between the electrode and the work. This thick layer of flux completely covers the molten metal, thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the process.

SAW is normally operated in the automatic or mechanized mode, however, semi-automatic (hand-held) SAW guns with pressurized or gravity flux feed are available. The process is almost universally limited to the Flat or Horizontal-Fillet welding positions. This limitation requires repositioning and turning of the material being welded to accommodate the SAW process.

Metal Inert Gas (MIG) and Gas Metal Arc Welding (GMAW)

MIG (GMAW) is a widely used welding process. MIG came about during WWII. It was developed to help produce weapons and equipment faster. It was then used in the postwar booming economy, mostly in shops and factories.

MIG stands for *metal inert gas.* The inert gas is caused to flow over the molten and cooling weld metal, thereby protecting it from oxidation that can lower mechanical properties of the work piece. In contrast to stick welding, the flux on the electrode melts and forms a gas to shield the puddle from the atmosphere and a slag cover to protect the cooling weld.

MIG (GMAW) welding offers a tremendous advantage over SAW as it is not position-limited as is SAW. MIG processes are capable of flat/horizontal, vertical and overhead welding. Not being limited to welding in a flat or horizontal position greatly expands the capabilities and use of MIG (GMAW) with robotic welding equipment.

In MIG, a spool of solid-steel or tubular wire is fed from the machine, through a linear drive, then out of a contact tip in the MIG gun. The contact tip is *hot*, or electrically charged. Whenever the trigger is pulled, it melts the wire for the weld puddle. This is accomplished in several ways, including short-circuit, globular, spray and pulsed spray welding.

In short-circuit welding, small droplets of molten wire, heated when short-circuited, flow together to make a puddle as they touch the base metal. Inert gas flows out of the gun and keeps the puddle shielded from the atmosphere, thus the term *metal inert gas.* Inert means the gas will not combine with another element, so inert gases, like helium and argon, are used to protect the weld. The spray mode employs finer droplets at higher voltage and amperage.

Later it was discovered that carbon dioxide, which is not actually an inert gas, worked well also. Accordingly, it was determined that it could no longer be called MIG, so it began to be called *gas metal arc welding* (GMAW). However, welders in the field continued to call it MIG and today GMAW is still commonly referred to as MIG.

MIG is usually used in shops and factories, because out in the field the wind displaces the shielding gas, which, ironically, is there to displace the wind. MIG can be used in the field if wind blocks are built around the welder.

Automatic and Semi-Automatic

MIG (GMAW) can be used automatically or semi-automatically. An example of automatic MIG is a robotic arm welding car frames at an automobile assembly plant. Semi-automatic MIG is when an operator holds the MIG gun and manipulates the weld pool. In automatic MIG / GMAW, an operator sets up and watches the machine.

Benchmark study MIG (GMAW) is proposed for building maglev guiderails and bridge beams. Currently, SAW is widely used in the U.S. for bridge beam work, however, in Europe and Japan MIG (GMAW) is most widely used. Maglev guiderails, as designed by the Germans, utilize MIG (GMAW) welding.

A recently performed benchmark analysis of welding technology for bridge structures was performed by members of the U.S. fabrication industry and participants from state DOTs and the FHWA. This analysis showed that the Japanese industry preferred MIG (GMAW) welding by 80-90% vs. SAW welding. European fabrication shops also showed preference for MIG (GMAW) technology, but at a somewhat lower level. Combined, the survey showed 64% MIG (GMAW) preferred usage outside the U.S. vs. 36% for SAW.

No Annual Operating & Maintenance Subsidy Required for High-Speed Maglev

Regarding the amount and source of funding needed to cover annual operating and maintenance expenses, there is none. The federal High-Speed Maglev Deployment Program requires all maglev projects to be financially self-sustaining following construction.

Because of the precision fabrication component relative to the project's guideway, its construction and deployment are such that there is no routine or recurring track adjustment required (nor operationally acceptable) to maintain high-speed maglev service. Alternatively, steel-wheel-on-rail operations require intensive track maintenance to sustain proper gauge, elevation, cross level and other track standards that become more stringent with increased operating speeds. Maintaining these stringent standards is further compromised when the track is shared with heavy freight operations, a phenomenon that applies strong geometric forces to the rails and causes a shift in their alignment that necessitates constant correction. The absence of a similar maintenance requirement for high-speed maglev is based on the fact that there is no unintended shift or movement in the guideway. The end result is that no annual operations and/or maintenance subsidy would be required to support the operation of the high-speed maglev system.

Projected revenue and cost information contained herein is based on the project's completed Draft Environmental Impact Statement (DEIS) as required under the National Environmental Policy Act (NEPA). Capital cost estimates for the Environmentally Preferred Build Alternative were prepared by MAGLEV, Inc., and are based on engineering plans, profiles and other engineering details and the use of the *PENNDOT Bulletin 50-Construction Cost Catalog* and other information for unit construction cost estimates. Cost information supplied by Transrapid International (developers of the maglev system) was also used in the development of the maglev system cost elements and operating and maintenance (O&M) costs.

Since no high-speed maglev project has been implemented in the U.S., a consulting group retained by the public sponsors conducted an independent cost/risk assessment study in 2004. Based on MAGLEV, Inc.'s target seven-year construction schedule for the entire 54-mile project (including contingencies and using conventional construction techniques), the cost study results were within 10% of the presented project cost.

Two investment grade ridership studies, with a Federal Railroad Administration appointed peer review panel of national experts, form the basis of these calculations. While the fare structure has not been finalized, and further revenue optimization will be studied, a fare structure of $5.00 between each station with 7.5-minute peak frequency of service intervals was used in the DEIS to provide an estimate of fare-based revenues.

Some passenger trips will comprise travel on more than one segment of the 54-mile route, thereby resulting in "passenger links", which represents the average number of segments traveled by each passenger in terms of route segments. Passenger link ridership differs slightly from total passenger trips, with each passenger trip averaging 1.2 to 1.3 links. Each link volume, plus special event trips, was multiplied by the $5.00 segment fare and then by an annual multiplier of 300 days of normal usage to produce the annual revenue estimate.

The forecast for the annual farebox revenue for the initial operation from the Pittsburgh Airport to downtown is $19,731,048. Additional non-farebox revenue accruing from advertising, extended parking, power & communications, naming rights, light freight, joint station development and other revenue sources is projected at $10,488,581 annually, for a combined total revenue forecast of $30,219,629 for the airport to downtown segment.

The annual O&M expenses for this initial segment are calculated to be $16,680,000. The basis for estimating O&M costs includes input from the technology supplier, Transrapid International, and staffing plans developed by MAGLEV, Inc. The O&M costs include maintenance of right-of-way, maintenance of vehicles, equipment and all guideway related infrastructure, labor for transportation of passengers and freight services, energy and utility supply, insurance and general administration expenses.

These projections provide an annual positive operating cash flow balance of $13,539,629 for the initial year of operations. An Operating Pro Forma Cash Flow Schedule highlighting operating revenues, costs, debt service and maintenance reserve fund balances for the entire 54-mile project over a thirty-five year operating schedule is attached. Note that the first column (year 2010) reflects only the initial airport to downtown segment as described above.

A Major Maintenance Reserve Fund is planned to be created from the surplus revenues generated by the project after O&M costs and debt service payments are covered. The reserve fund is designed to support vehicle replacements and major infrastructure reinvestment capital after twenty years of service. However, if the initial segment(s) is/are funded through the current high-speed section of the American Recovery and Reinvestment Act up to 100% federal funding, there should correspondingly be a reduced debt service component.

The financial projections prepared for this project are based on federal funding proposals that were in place at the time the DEIS was prepared. This includes federal funding limited to $950 million with state matching funds of $475 million plus other funding sources including $570 million in revenue bonds, TIFIA loans, $795 million of other equity funds and approximately $124 million of Available Resource Elements (A.R.E.) funds to be used to pay for road improvements as identified in the Long Range Plan (2030) of the Southwest Planning Commission (SPC). The $795 million equity source category includes a variety of funding alternatives including private investment funds, additional revenue bonds, revenues associated with zone fare and station optimization, contractor subordinated debt, tax credit bonds and additional public grants.

Funding through these mechanisms would require a debt service on behalf of the project, but it is still projected to result in an annual surplus over operating and maintenance costs as projected in the DEIS and the attached schedule. Specifically, the surplus revenues accumulated after meeting operating and maintenance costs and debt service payments for the entire 54-mile project over the first thirty-five years of operations will result in a Major Maintenance Reserve Fund balance of $871,500,604. But once again, if the project is funded largely through the current American Recovery and Reinvestment Act up to 100% federal funding, there should correspondingly be a smaller debt service component and the positive cash flow balance would result in hundreds of millions of additional dollars that could be used to further finance expansion of the self-sustaining system.

In summary, the Pennsylvania High-Speed Maglev Project offers an unprecedented opportunity to establish long-term high-speed rail service without the need for an annual operating subsidy.

{The above financial data and following pro-forma schedule are based on information included in the Draft Environmental Impact Statement. This information will be updated prior to the issuance of a Record of Decision (ROD).}

Operating Pro Forma Cash Flow Schedule

Budget Item	2010	2015	2020	2025	2030	2035	2040	2045
Farebox Revenue	19,731,048	105,314,790	127,561,898	154,518,753	187,184,051	226,768,522	274,739,993	332,878,025
Other Revenue	10,488,581	52,556,304	67,489,269	79,738,515	94,258,394	111,478,680	131,912,108	156,170,693
Total Revenue	30,219,629	157,871,094	195,051,167	234,257,268	281,442,445	338,247,202	406,652,101	489,048,718
O&M Expenses	16,680,000	40,791,499	47,288,527	54,820,364	63,551,826	73,673,984	85,408,340	99,011,674
Operating Cash Flow	13,539,629	117,079,595	147,762,640	179,436,904	217,890,619	264,573,218	321,243,761	390,037,044
Plus: Interest Earnings	X	2,838,541	2,838,541	2,838,541	2,838,541	2,838,541	2,838,541	2,838,541
Senior Debt Service	X	58,539,797	29,667,954	58,462,740	93,420,663	132,286,609	X	195,018,522
TIFIA Debt Service	X	X	104,661,718	104,661,718	104,661,718	108,234,498	292,039,782	X
Net Operating Cash After Debt Service (Transfer to Major Mainten-ance Reserve)	13,539,629	61,378,339	16,271,509	19,150,987	22,646,779	26,890,652	32,042,520	197,857,063
Balance of Major Maintenance Reserve	13,539,629	291,721,643	418,699,313	580,526,344	289,758,880	309,768,999	450,984,225	871,500,604
Senior Debt Outstanding Par Amount	567,708,210	382,004,505	321,010,196	209,824,609	123,670,552	32,414,855	26,258,061	12,932,445
TIFIA Debt Outstanding	1,543,540,518	1,993,556,537	1,993,556,537	1,993,556,537	1,993,556,537	1,989,983,757	1,132,727,684	X

This table highlights operating revenues, costs, debt service and maintenance reserve fund balances over a thirty-five year period. It is based on the following assumptions:

* Total Revenue includes ridership and non-farebox revenue;
* Non-Farebox revenue includes naming rights, advertising, freight, extended parking, joint development and other revenue sources;
* Ridership growth rate is based on the regional data provided by the SPC. Ridership growth beyond the SPC Long Range Planning year of 2025 (or 2030) is based on population and employment growth rate in the Long Range Planning years prior to 2025 (or 2030);
* Only the first section from Pittsburgh International Airport to downtown Pittsburgh will be in operation by the year 2010 with the remaining sections coming on line in 2011 and 2012 respectively;
* All costs and revenues are inflated at an annual growth rate of three percent;
* Based on customary rating agency requirements, debt service coverage ratio on senior debt (the current interest and capital appreciation revenue bonds) must be a minimum of two times to obtain the investment grade rating requirement for TIFIA credit assistance;
* Maximum TIFIA financing is limited to thirty-three percent of total project cost;
* TIFIA requires minimum agregate debt coverage of 10.1;
* Debt service is based on current bond market rates;
* Senior debt interest rates assume an investment grade rating in the "Triple-B" category;
* The Maintenance Reserve Fund balance is sufficient to fund vehicle replacements and major infrastructure capital improvements starting in year twenty of operation.

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The Operating Pro Forma Cash Flow Schedule was developed with the assistance of the project investment banking committee of Citigroup Global Markets, Inc. (now Morgan Stanley Smith Barney), Raymond James Associates and PNC Capital Markets. The finance plan and associated pro formas are based on reasonable assumptions that would result in a financially successful project implementation and a sustainable operating entity into the foreseeable future. In order to ensure that the revenue bonds are marketable an that the TIFIA credit assistance is available, it will be necessary to receive one or more investment grade ratings on the revenue bonds.

Following completion of the EIS process and the issuance of a ROD from the FRA, an independent review by investment bankers of the project's construction cost, schedule, projected revenues, and operating costs will be conducted in preparation of the bond ratings for the project.

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United States Patent [19]

Cioletti et al.

[11] **Patent Number: 5,823,114**

[45] **Date of Patent: Oct. 20, 1998**

[54] **UTILITY DISTRIBUTION SYSTEM INCORPORATING MAGNETIC LEVITATION VEHICLE GUIDEWAYS**

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[51] **Int. Cl.**[6] **E01B 25/00**

[52] **U.S. Cl.** .... **104/124**; 191/23 R; 191/25

[58] **Field of Search** .... 104/123, 124, 104/125, 126, 118, 281, 282; 191/23 R, 25, 26, 27; 52/220.1, 220.2, 220.3, 220.5, 220.7; 404/71

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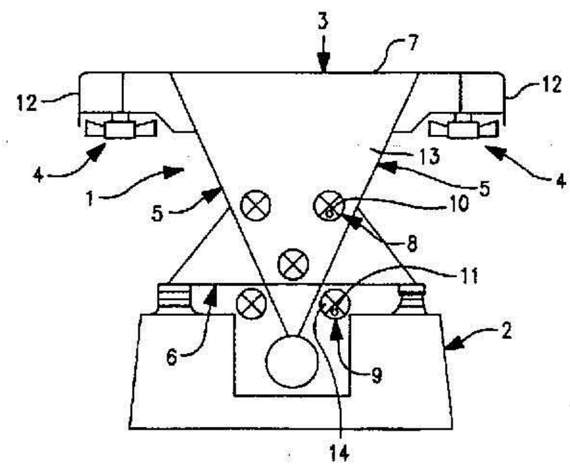
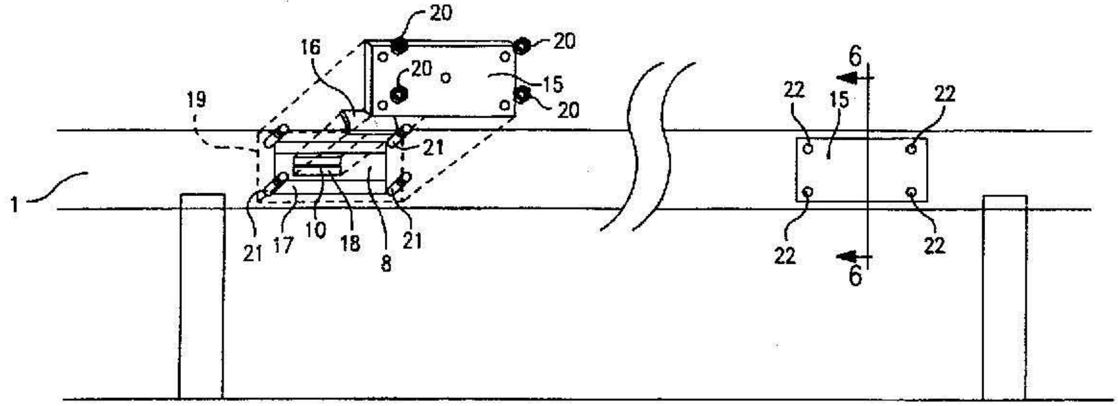
[57] **ABSTRACT**

A utility transmission and distribution system includes a guideway for a magnetic levitation transportation system, and supports for supporting the guideway above the ground. The guideway includes a base connected to a structure defining an enclosed channel. At least one conduit defining an enclosed space is disposed within the channel, and is rigidly connected to the channel such that movement over the guideway remains unimpeded. At least one cable is disposed within the conduit for transmitting and distributing utilities.

4 Claims, 4 Drawing Sheets





UTILITY DISTRIBUTION SYSTEM INCORPORATING MAGNETIC LEVITATION VEHICLE GUIDEWAYS

BACKGROUND OF THE INVENTION

The present invention relates generally to utility transmission and distribution systems, and more particularly to a system to effect such distribution and transmission in conjunction with guideways for magnetic levitation vehicles and transportation systems.

Electrical wires and cables are typically suspended above the ground via a series of large, metallic towers. Such high tension wires and supporting towers are unsightly, susceptible to weather conditions, difficult and dangerous to maintain, and may be dangerous to humans due to the electromagnetic pulse that emanates from the wires. Many communities and landowners resist the installation of such towers and are apprehensive of the potential harmful effects associated with the wires and the diminished value of the land over which the high tension wires travel.

Burying the wires and cables in the ground reduces the wires' and cables' exposure to the weather and eliminates the need for unsightly towers. However, buried cables and wires are difficult to access in that they have to be uncovered by excavating the ground under which they lie. Conversely, buried wires and cables are susceptible to being damaged and severed by indiscriminate excavations by other utility services and construction workers. Additionally, land and easements must be acquired for the buried wires and cables.

In an age of increasing competitiveness in the fields of telecommunications, computer networks, and electrical power distribution; increasing public and landowner opposition to unsightly towers and potentially harmful high tension wires; and increased difficulty and costs involved in obtaining rights-of-ways and easements for utility transmission, an alternative to high tension wires and towers and buried cables is needed. In particular, in an increasingly national and global market where utility companies, including electric suppliers, wish to supply services to people and companies outside of their local geographic area, a means to convey energy, signals, and communications cross-country without having to install high tension wires and buried cables across long distances is desired.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, a utility distribution system includes a guideway for use in a magnetic levitation transportation system, and supports for supporting the guideway above the ground. The guideway includes a base rigidly fixed to a structure defining an enclosed channel, at least one conduit disposed within the enclosed channel of the guideway, and a utility transmission device disposed within the conduit.

According to a second aspect of the present invention, a utility distribution system includes a guideway for use in a magnetic levitation transportation system, and supports for supporting the guideway base above the ground. The guideway includes a base rigidly fixed to a structure defining an enclosed channel, at least one conduit disposed outside the enclosed channel and a utility transmission device disposed within the conduit.

It is, therefore, an object of the present invention to provide an alternative to high tension wires and buried cables for the cross-country transmission of electrical power, signals, and communications. Installing wires and cables for

the transmission and distribution of electricity, signals, and communications along and/or inside of guideways for magnetic levitation vehicles provides an opportunity to protect the wires and cables from extreme weather conditions and errant excavations without having to go through the costly process of procuring land and easements and erecting towers or excavating ditches because the land for the guideways will already have been acquired. Additionally, the mutual benefits and opportunities of a magnetic transportation system coupled with an utility transmission distribution system will draw more public and private investment, financing, and assistance to construction of such cross-country systems and will draw less public opposition.

It is another object of the present invention to reduce maintenance costs and problems by allowing easier access to the utility transmission wires and cables while concurrently protected such cables and wires from exposure to the elements and inadvertent damage from errant excavations.

It is yet another object of the present invention to provide cheaper and more ready access to utilities for rural consumers along the guideway path than is currently provided by local utility companies. The ability of low cost utilities to transmit and distribute utilities outside of their geographic regions will lead to increased competition among utility suppliers and hence lower utility prices for utility consumers in general.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view taken along line 2—2 of FIG. 2 showing multiple potential locations for utility transmission devices;

FIG. 2 is an elevational view of a magnetic levitation guideway and supports for attaching the guideway above the ground showing multiple potential locations for utility transmission devices;

FIG. 3 is an enlarged view of the conduit and utility distribution device shown in FIG. 1;

FIG. 4 is an exploded view of the components of the magnetic levitation guideway;

FIG. 5 is an elevational view of an access panel in the guideway and conduit shown in FIGS. 1–4; and

FIG. 6 is a cross-sectional view taken at the midpoint of the access panel in the guideway shown unconnected to the guideway in FIG. 5 showing the access panels in the guideway and conduit.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

The utility distribution system of the present invention consists of a guideway 1, at least one conduit 8 disposed within the structure of the guideway or one conduit 9 disposed on the outside surface of the guideway, and a utility transmission device 10, 11 within each conduit, as depicted in FIGS. 1 and 2.

The guideway 1 in the preferred embodiment is constructed of steel and consists of the following elements, as best depicted in FIG. 4: a base 3 over which movement takes place, side guide rails 12 connected to either side of the base 3 and flush with the upper surface (the surface facing away from the ground) of the base 3, profiles 4 rigidly fixed to the bottom surface (the surface facing the ground) of the base 3, and two transverse flange plates 5 forming an inclined web attached fixedly between the bottom surface of the base 3 and the lower flange plate 6. The distance between the inner faces of the transverse flange plates 5 decreases from a