IRON THAT WILL NOT RUST.

In 1856 Sir Henry Bessemer invented a process of steel making which revolutionized the iron and steel business. By this method it was possible to turn out an immense tonnage at a low cost and with a low percentage of carbon and manganese. To be able to produce in large quantities and at a low cost a metal which had even greater tensile strength and ductility than good iron, at once enabled steel to take the place in commerce hitherto held by iron.

While steel had a greater tensile strength and greater rigidity than iron, it had certain limitations which have grown increasingly apparent. These limitations appear in the use of steel where it is subject to severe corrosive agents; as, for example, in the atmosphere of cities impregnated by the fumes of gas or coal smoke, at the seashore with its salt air, in the ground with its dampness, or in localities where it becomes the intermittent conductor of electrical currents. Steel has come to be considered, under these conditions, and notwithstanding its extreme hardness of texture, a comparatively short-lived metal.

Iron nails, taken from demolished houses that were built in the eighteenth century, are handed about as curios; for to-day, in many a shingled roof, the shingles outlast the steel nails. The Department of Agriculture voiced the sentiments of the farmer when it urged upon wire makers the necessity of improving the character of the wire fence, so that the farmer using it would not have to renew it every five to nine years. The thrifty housewife, pleased with the beauty and strength of her new galvanized water pail, is surprised and indignant at having her maid call her attention, as it seems to her after a very short time, to the holes in the bottom.

It is generally considered a plausible, if not demonstrated theory, that this fugitive nature of steel comes from its chemical structure. The elements introduced into the molten mass of iron in the furnace and in the ladle to convert iron into steel are essentially impurities. Under certain conditions an electrolytic action is set up within the structure of the steel between these impurities, with a resultant disintegration of the metal.

There is a growing conviction that the corrosion of metals is due to this electrolytic action. According to the latest theory, rusting commences on the surface of the metal because of a difference of potential there, a condition which is due to the impurities in the metal, such as carbon, sulphur, phosphorus, and particularly manganese. Dr. A. S. Cushman, in a pamphlet entitled "The Corrosion of Fence Wire," published by the United States Department of Agriculture, arrived at the conclusion that steel corroded more rapidly than iron for several reasons, chief among which were the following:

First. The presence of and the irregular distribution of manganese in steel, there being little if any of that substance present in iron.

Second. The greater destruction of steel by electrolysis as compared with iron, due to the presence of manganese and various metalloids in greater quantities than in iron.

Third. The absence of slag in steel, whereas the slag distributed throughout iron was believed to act as a rust preventive.

The same authority says: "If we accept the electro-chemical explanation of the corrosion of iron, there can be no doubt that conditions which inhibit electrolytic effects also inhibit corrosion, and *vice versa*. The purer the iron in respect to certain metals which differ electro-chemically from iron, and the more carefully the lack of homogeneity and bad segregation are guarded against, the less likely are the electrolytic effects to become serious. These points constitute the essential problems which confront the manufacturer who desires metal that will have a high resistance to corrosion."

A few years ago the American Rolling Mill Company, of Middletown, Ohio, began to investigate the possibility of producing from their open-hearth furnaces, from which they were making high-grade steel by the usual method, a steel very low in carbon and manganese. The success achieved in this direction suggested that it might be possible to reduce the scrap and pig iron to a molten mass in an open-hearth furnace and cast it into ingot iron, without introducing the impurities that are known to be active agents in corrosion.

In making steel by the open-hearth process, the furnace is charged with many tons of selected scrap and pig iron, and the charge is raised to a sufficient temperature to burn out the carbon and the greater part of the other impurities. When these have been reduced to the desired extent, a predetermined amount of carbon and, in particular grades of steel, of other ingredients, is added to the molten metal, until its composition has been brought to the exact point called for by the specifications for the particular grade of steel which is being made. In the experimental work of the company above referred to, the treatment was entirely one of elimination, the effort being to get rid of practically the whole of the impurities, and bring the metal as nearly as possible to the condition of absolutely pure iron. They carried the process of burning out the impurities even further than is done in the manufacture of commercial steel; and there the process stopped, leaving in the bath a remarkably pure iron, which was subsequently cast into ingots, and was available for use in the rolling mills and elsewhere for manufacture into commercial products.

An analysis of this iron in comparison with commercial steel, as made by William M. McPherson, professor of metallurgy, Ohio State University, Columbus, Ohio, showed the following results:

	Steel.	American Ingot Iron.
Sulphur	0.048 per cent	0.021 per cent
Phosphorus	0.094 per cent	0.005 per cent
Carbon	0.11 per cent	0.02 per cent
Manganese	0.47 per cent	Trace
Silicon	Trace	Trace

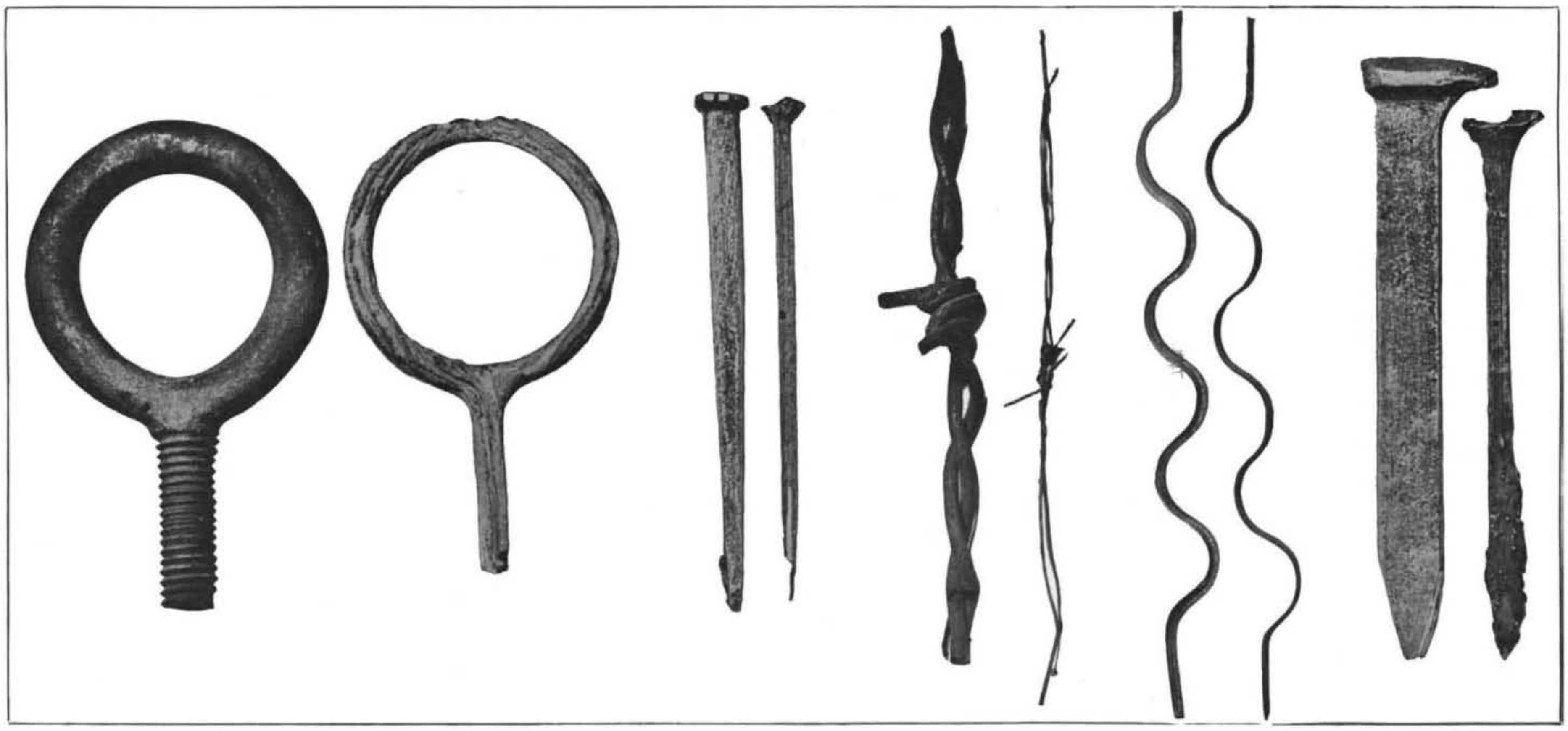
The corrosion test of the above samples, which were immersed in a 5 per cent solution of sulphuric acid for twenty-four days, showed:

Loss, steel	14.41 per cent
Loss, American ingot iron	0.21 per cent

"The above material," says the report, "is very exceptional for its purity, and is the most non-corrosive material that I have examined."

Four specimens of ingot iron subjected to tests to determine its tensile strain showed the following results: Breaking strain per square inch, from 49,857 pounds to 51,905 pounds; limit of elasticity per square inch, from 35,395 pounds to 41,377 pounds; elongation per cent of length, from 40 per cent to 48 per cent.

We present a set of comparative illustrations, showing the results of corrosion tests on various articles of commerce, one of each pair being made of the new ingot iron, and the other of steel or other material. In every case, both specimens were immersed in a bath of 25 per cent sulphuric acid. The ingot iron and charcoal eyebolts were treated in the bath for six hours, at the end of which time the ingot-iron eyebolt showed a loss of 15.5 per cent, and the charcoal-iron eyebolt a loss of 77.3 per cent. In a five-hour test of two railroad spikes, the ingot-iron specimen lost 11.2 per cent, and the steel spike 79.1 per cent. Even more remarkable was the comparison of ingot-iron and barbed-wire fencing material, the steel wire losing 92.3 per cent at the end of one and a half hours, and the ingot-iron wire losing only 6.1 per cent. In a forty-five minutes' test of two nails, the steel nail lost 68.9 per cent, and the ingot-iron nail 4.13 per cent. The two specimens of corrugated roofing material were placed in the bath for fifty minutes, at the end of which time the steel specimen had lost 78.2 per cent, and the ingot iron 2.4 per cent.



Ingot iron. Loss, 15.5%. Charcoal. Loss, 77.3%. Ingot iron. Loss, 4.13%. Steel. Loss, 68.9%. Ingot iron. Loss, 6.1%. Steel. Loss, 92.3%. Ingot iron. Loss, 2.4%. Steel. Loss, 78.2%. Ingot iron. Loss, 11.2%. Steel. Loss, 71.9%.

CORROSION TESTS IN BATH OF 25 PER CENT SULPHURIC ACID.

CHICAGO'S SIXTY MILES OF FREIGHT SUBWAY.

In our Engineering Number of December 5th of last year we illustrated a system of freight subway which had been proposed for solving the serious problem of freight congestion on the streets of this city. In the present Middle West Number we present illustrations of a complete system of freight tunnels, aggregating sixty miles in length, which has been completed below the business center of Chicago, and is now regularly engaged in conveying merchandise and the city's mail directly to and from the railways, the Post Office, and the various office and commercial buildings of the city. The Chicago freight tunnels stand as a unique achievement among the great municipal undertakings of the world; and the capital city of the Middle West very justly prides itself upon the magnitude and completeness of this constructive work, which ranks in importance with that other great Chicago enterprise, the Drainage Canal.

The underlying conditions which have led to the construction of the subway are the same as those that have prompted two powerful construction companies to make an offer to build a similar freight subway system beneath New York city, namely, the intolerably congested condition of the street traffic. It is the slow-moving and bulky dray and the various freight and express vehicles that are chiefly responsible for the growing street congestion in the business centers of our great cities. It is claimed that, before the construction of its tunnel system, the conditions in the heart of Chicago were worse than in any other city,

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Southern Pacific, and on the level it would be capable of hauling a train weighing 10,000 tons and carrying about 7,000 tons of freight at a speed of ten miles an hour.

CHICAGO'S SIXTY MILES OF FREIGHT SUBWAY.

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not even excepting New York. The many trunk railroads which center in Chicago have done their best to shorten the haul to and from the freight terminals and the various business houses, for if one looks at a map of Chicago it will be seen that these terminals are located in the very heart of the city, and that they have reached a point beyond which, because of the high value of land, they cannot possibly go.

The credit for the solution of the problem of freight distribution is due to Albert G. Wheeler, who several years ago applied to the City Council for a franchise on behalf of the Illinois Tunnel and Telephone Company for the construction of a system of tunnels which should be used for the transmission of "sounds, signals, and intelligence by means of electricity or otherwise." The franchise was granted and work was commenced in a very unostentatious manner, the necessary capital being found by private parties. The lines as now completed extend from Armour Avenue and Archer Avenue on the south to Chicago Avenue and Kingsbury Street on the north to Green Street on the west. The greater part of the sixty miles of tunnel is six feet in width and seven and a half feet in height, but there are also trunk tunnels which are twelve feet in height and vary in width from ten to fourteen feet. It was stipulated that the floor of the tunnel should be about forty feet below the street level, and as it is generally seven and a half feet high, it follows that the tunnel roof is about thirty-three feet below street level. By constructing the system at this depth all interference with the water and gas pipes and sewers of the city was avoided, and sufficient room was left for the construction of a complete passenger subway system between the street surface and the tunnel whenever the city should be prepared to take up such a work.

It was stipulated in the franchise that the tunnel must be built below the center line of the streets, and this has been done. In prosecuting the work, shafts were sunk, as a rule, in the basements of various buildings, which were rented for the purpose of the tunnel company; and these basements were used for mixing the concrete and for installing the air-compressing plants which supplied the necessary air at ten pounds pressure for the pneumatic system under which the whole work was prosecuted. From the shafts above mentioned the workmen drifted out to the center of the street, where the work of excavation was carried on in opposite directions. In the earlier years of construction the material was hoisted to street level, loaded into contractors' carts, and hauled to the dumping ground on the lake front; this work being done entirely in the night time, to avoid any interference with the already crowded traffic of the day time. In later years the dump cars have been run to the surface by means of an incline and hauled by electric locomotive to the lake front,

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Hair tonic, S. Tsorones 941,434
Harvester reel support, J. A. Scanland...... 941,655
Hasp lock, A. J. French 941,511
Hat, felt, E. L. Wales 941,746
Hats and other head coverings, sweat band for, J. W. Kolsch 941,717
Hatch cover and operating means therefor, L. D. Lovekin, et al.................... 941,526
Heat retainer, F. H. Daniels................ 941,858
Heater. See Air heater.
Heater, Bowman & Becraft 941,910
Heating and melting furnace, W. N. Best.. 941,609
Hinge, invisible, H. R. Canfield............ 941,672
Hitching and steering device, L. B. McAlpine 941,939
Hoisting appliance, I. C. Moulton 941,722
Hollow bodies, means for extruding, A. P. Hine 4 941,365
Hopper and soil pipe cleaner, extension, W. H. Cloak 941,558
Horse boot, R. H. Smith 941,819
Horseshoe, T. L. Randall 942,012
Hose coupling, air, F. W. Rock 941,652
Hose coupling, expansion, H. C. Bostian.... 941,355
Hose rack, G. F. D. Trask.................. 941,410
Hot water house heater, M. A. Wilcox...... 941,597
Hub attaching device, C. C. Swanson....... 941,470
Hydraulic jack, E. A. Gathmann........... 941,870
Hydraulic separator, W. F. Smith........ 941,663
Ice-making apparatus, D. J. Havenstrite.... 941,414
Indicator, A. J. Border.................... 941,354
Indicator, H. E. Golden 941,872
Induction furnace, M. Unger 941,435
Insect destroyer, A. Swainson 941,742
Instrument and medicine case, C. B. Benson 941,608
Insulating bodies, producing, Noodt & Gottsche 941,585
Insulating coverings for electric conductors, Phillips & Hutchins 941,810
Internal combustion engine, R. Lucas....... 941,376
Ironing board cover, E. Stone 941,430
Jar closure, G. Henderson 941,417
Jar closure, J. Schies 941,538
Jewel setter's tool, F. C. Widmann........ 941,831
Jewelry box, J. R. Sundee 941,741
Joint connection, universal, Jourdain & Dextraze 941,928
Journal box, L. K. Smith 941,661
Keyhole illuminating device, Hardin & de Saussure 941,576
Keyless socket, C. D. Platt 941,811
Kinematograph apparatus for the production of colored pictures, G. A. Smith........ 941,960
Kitchen rack, foldable, R. Hothengatter.... 941,653
Knob fastener, door, F. E. Beardsley........ 941,906
Lamp adjustable support, electric, L. Erikson 941,863
Lamp, incandescent, R. D. Tiffany........ 941,593
Lamp, miner's, J. & A. M. Van Liew...... 941,897
Lamp operating device, vehicle, J. P. Stein.. 941,739
Lamp socket switch, incandescent, W. A. McDonald 941,941
Lamps, sealing filament carriers into bulbs of electric incandescent, J. Kremenezky 941,996
Land roller, E. Englund 941,770
Lantern, O. R. Henson 941,922
Lantern, signal, J. J. McIntyre............ 941,803
Last, H. F. Loewer 941,373
Last, shoe, A. C. Hayden 941,451
Latch bolt for doors, J. R. Potts.......... 941,689
Lathe, L. H. Vold 941,475
Lathe, C. D. Fischer, Jr. 941,701
Leaf holder, loose, E. E. Tait 941,963
Leather staking machine, A. C. Brill....... 941,851
Ledger, loose leaf, H. F. Bushong.......... 941,757
Level, M. Ichtertz 941,368
Life saving apparatus, M. A. Mueller....... 942,009
Loading and unloading device, T. Fullbright. 941,571
Lock, Foster & Dreska.................... 941,570
Locks and latches, safety guard for, G. E. Hosch 941,877
Locomotive ash pan, F. L. Roberts.......... 941,815
Locomotive track sander, H. L. Lambert.... 941,457
Loom let off mechanism, J. Northrop........ 941,380
Loom picking motion, W. H. Ayer........ 941,844
Lymph, making preventive and curative, S. Krafft 941,423
Mail, express, and train orders, despatches, etc., apparatus for effecting the interchange of, N. J. Nelson.................. 941,461
Manhole cover plate, E. Oldman............ 941,531
Manure spreader, D. Garst 941,513
Manure spreader, Littlefield & Garst, reissue 13,047
Match scratcher, G. A. Barnes............ 941,487
Measuring apparatus, G. A. Cowen......... 941,359
Measuring apparatus, hat frame wire, W. M. Jameson 941,637
Measuring instrument, optical distance, F. Dubenhorst 941,503
Mechanical movement, R. T. Johnston...... 941,639
Medicine dispenser, F. M. Beverly.......... 941,489
Merry-go-round, C. W. Ott................ 942,041
Merry-go-round, Powell & Miller........... 942,010
Metal sheets, manufacturing, C. W. Bray.... 941,850
Meter, W. L. Gumprecht 941,573
Milk pasteurizer and cooler, W. R. Thatcher. 941,964
Milking machine, K. I. Lonstrom 941,789
Miter clamp, J. L. Taylor 941,825
Mixing machine, O. H. Weckesser.......... 941,830
Molding machine, Kerlin & Bowen........ 941,930
Molding machine, W. Lewis 941,999
Motor control system, H. E. White........ 941,397
Motor generator set, W. A. Danielson........ 941,439
Motor more especially applicable for driving barges, wherries, flatboats, and the like, G. Trouche 941,827
Motor starter, M. R. Hanna 941,412
Music record sheet for automatic piano playing mechanism and the like, A. R. Trist. 941,433
Musical instruments, note accenting device for, T. P. Brown...................... 941,491
Negative developer, J. S. Miller........... 941,643
Net frame, landing, F. M. Spiegle.......... 941,961
Nozzle, regulating, W. A. Doble 941,440
Nut lock, K. & B. Nagyvathy................ 941,804
Nut lock, W. W. Senn...................... 941,959
Oar rack, E. G. Hodgkins 941,779
Oil burner, J. Weintz 941,479
Oil burner, J. N. Young.................. 942,028
Optometer, J. H. Martin.................. 941,581
Optometer, H. L. De Zeng................ 941,766
Ore separating or concentrating apparatus, G. F. Godley 941,634
Ores, treating certain, H. S. Auerbach...... 941,904
Oven door, bake, J. M. Hoepfl.............. 941,780
Package tie, G. L. Hindman 941,780
Packing machine, F. Rassino................ 941,444
Packing material, L. H. Baekeland.......... 941,605
Packing, piston rod, A. J. West............ 941,394
Packing ring, piston, T. H. Renaud........ 941,536
Packings, lap joint for, J. T. Wilson...... 942,024
Pad. See Finger pad.
Pail, dinner, W. A. Edwards 941,915
Paper making apparatus, W. H. Decker.... 941,561
Paper making machine, J. A. White........ 941,968
Paper making machine cleansing device, A T. Wyant 941,750
Paper package, toilet, G. T. Johnson........ 941,715
Paper receptacle, C. F. Jenkins 941,992
Paper sheets together, machinery for separating, feeding, and cementing, W. Fricker 941,868
Paste to cardboard, etc., machine for applying, J. McKibbin.................. 941,530

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where already an addition has been made to the area of the city's park of about twenty acres. As the average fill is forty feet in depth, it can be understood that, had this enlargement been made by the city itself, it would have cost about $600,000.

The system is operated entirely by electricity, and the equipment consists at present of 175 motors of the Jeffrey and the General Electric types and 3,502 cars. There is a telephone installed on every block, and the movements of the trains are directed entirely by this means.

Although the wording of the franchise would indicate that the tunnels were to be constructed primarily for the installation of telephone and telegraph lines, it will be understood that the greatest revenue-earning power will be derived from the transportation of freight. It is estimated that about one hundred thousand tons of freight are hauled through the streets of Chicago each day; and if the tunnel company should haul only one-third of this, the total for the year would amount to over ten million tons. Hitherto no great effort has been made to push this branch of the business; but now that the system is about completed, it is expected that full connections will be made with the various business houses, and great increase in traffic will follow. Connection between the various warehouses and the tunnels is made by sinking a shaft and equipping it with electric elevators, which run from the track level below to the particular floors of the warehouse upon which the freight is to be delivered. In the case of a big warehouse, such as Marshall Field & Company, the loaded cars are hoisted to the desired floor, unloaded, loaded with the outgoing freight, returned to the tunnel, and drawn to the particular railroad freight station desired. It will not, of course, be possible to have direct connection between warehouse and tunnel in every case, and hence central depots will be provided at various suitable locations throughout the city, so placed that the average haul by team will not amount to more than one or two blocks. One immediate advantage of the system is that the wholesale houses are now able to carry on business throughout the twenty-four hours of the day. Under present conditions, after the teams have gone home for the night, the goods that are ready for shipment have to wait until the following day; and at busy seasons of the year it is not unusual for a delay of several days to occur. By using the tunnel system, the merchant can make immediate shipments of his freight, whether it consists of one truckload or fifty.

The tunnels will serve many useful purposes outside of that of transportation of merchandise. One of these, and a very important one, is that of the hauling away of material from the excavations for buildings within the city. Hitherto, this has been done by teams upon the surface; but the present method is to run a steel chute from the excavation down to the tunnel on an angle of about forty-five degrees. The workmen wheel the material to the mouth of the chute, and dump it; and it is received and drawn away by cars, which are successively moved below the mouth of the chute in the tunnel. When a train has been made up, an electric locomotive hauls it to the dump on the lake front. By this method as much as 2,100 cubic yards of material has been removed from the basement of a single building in one day. The best that has ever been accomplished by teams in the same time is 420 cubic yards. Another important service rendered is that of bringing coal to the boiler plants of the various houses and the hauling away of ashes and other refuse.

In no direction has the tunnel proved more successful than that of the transportation of mail. A twelve by thirteen-foot subway has been constructed below the United States Post Office building, ex-

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Peanut shelling machine, R. M. Newland.... 941,686
Pen, composite, J. F. Betzler 941,403
Pen, reservoir, W. W. Sanford.............. 941,466
Pencil holder and sharpener, combined, C. H. Haase 941,518
Pencil sharpener, R. F. George 941,631
Perforating machine, L. W. G. Flynt 941,704
Phonograph attachment, H. A. Smith 941,546
Piano player, electropneumatic, A. R. Trist. 941,432
Piano tuning pin, Sack & Tyler 941,730
Pipe hanger support, R. A. Jenckes........ 941,714
Pistol, automatic, R. Wiles 941,749
Pitman box, C. M. Jennings 941,638
Plant pulling implement, W. H. Miller..... 941,644
Planter attachment, W. C. Reynolds....... 941,971
Planter, corn, A. J. Anderson.............. 941,485
Planter, corn, G. M. Gorman 941,874
Planter, potato, W. A. Hall, Sr............ 941,449
Planter, seed, W. N. Jay 941,579
Planter shoe truck, Kilby & Kerr 941,421
Plate bar heating furnace, L. C. Steele..... 941,738
Plates and sheets, manufacture of, D. S. Brookman 941,854
Plates and sheets, manufacture of, S. A. Davis 941,861
Plow, E. M. Buckhannan 941,614
Plow, disk, Sholar & Pace 941,817
Plow fender, double shovel, Fairs & Walker. 941,772
Plow points, automatic device for attaching and releasing, Logan & Barnett 941,933
Plow, reversible disk, E. H. Sholar 941,818
Plow, sulky, W. H. Lee 941,887
Plows, spreading attachment for, H. M. Jack 941,369
Pneumatic cleaner, S. Markstein 942,037
Pole, vehicle, C. B. Schleichter............ 941,386
Power operated machine, safety trip device for, C. F. Pfalzgraf 941,726
Primary battery, C. E. Hite................ 941,366
Printing and folding machines and the like, automatic sheet feeder for, H. Hollings 942,036
Printing in colors, J. R. Brown 941,670
Printing machine, combined perfecting or two-clor, H. A. W. Wood............... 941,598
Printing press sheet feeding apparatus, C. Hermann 941,778
Projection apparatus attachment, W. J. Ashley 941,752
Pulp shaping machine, A. Komp 941,884
Pump, A. W. Schramm...................... 941,958
Pump, centrifugal, D. V. Burrell.......... 941,557
Pumping or forcing mechanism, air, H. Harsant 941,450
Puzzle for the blind, raised, M. A. Houghton 941,680
Rail fastener, G. M. Cote 941,697
Rail fastening device, J. E. Hanique...... 941,575
Rail joint, M. Thorson 941,473
Rail joints, splice bar for, W. P. & S. G. Thomson 941,472
Rail tie, Churchill & O'Neill.............. 941,913
Railway and rail support therefor, W. L. Remer 942,032
Railway joint, G. W. Amos 941,604
Railway rail, S. W. Lyman 941,580
Railway rail brace, E. J. Anthony......... 941,693
Railway rail locking mechanism, E. J. Anthony 941,692
Railway switch device, G. R. Johnson...... 941,522
Railway switches, manufacture of slide plates for, R. J. Davidson............... 941,623
Ratchet drill, G. W. Figg 941,916
Razor blade clamp, A. H. Fleming......... 941,566
Reamer, A. E. Church 941,912
Refrigerating apparatus, W. W. Seay...... 941,733
Refrigeration, process, W. W. Seay........ 941,734
Register or ventilator, E. D. House....... 941,367
Register or ventilator, H. S. Hart......... 941,413
Relay, T. W. Gleeson 941,709
Relay, Corwin & Bals....................... 941,761
Rheostat, G. H. Dorgeloh 941,441
Ribbon reversing mechanism, automatic ink, R. E. Benner 941,554
Rifle practice, sand box for, H. P. Maxim.. 941,642
Ring clamp, F. C. Widman 941,832
Road and land leveling machine, W. Kaiser 941,929
Road and street construction, J. H. Amies. 941,548
Rock drill, internal combustion, L. L. Scott. 941,731, 941,732
Roller. See Land roller.
Rolling ribbed bars, T. W. Jenks 941,880
Rotary combustion engine, F. Fleming...... 941,567
Rule, P. F. Burns 941,492
Rule, G. A. Mongelli 941,936
Sad iron, C. W. Wodzuski 942,026
Safe, revolving, J. S. McCormick........... 941,940
Sanding, abrading, or polishing machine, F. Schimmel 941,957
Sash, metal window, F. E. Duering......... 941,629
Saw, R. Hoe, Jr. 941,455
Saw, A. P. Fridstrom 941,705
Saw joiner and gage, C. C. Du Bose....... 941,981
Saw resawing machine, band, C. E. Cleveland 941,758
Scale, W. F. Stimpson 941,590
Scale, automatic weighing, M. E. Reisert... 941,588
Scale, weighing, A. H. Neureuther 941,725
Self-sealing can, J. F. Ross............... 941,729
Sewing machine power transmitter, A. B. Cohn 941,857
Shade hanger, window, B. F. Gindlesperger. 941,987
Shaker screen, vibrating, L. C. Dibert.... 941,862
Sharpening device, razor, W. H. Dunn..... 941,564
Sharpening machine, coal puncher, J. B. & W. W. Word 941,484
Sharpening razors and razor blades, device for, F. Myers 941,529
Shears, J. R. Seabright.................... 942,043
Sheet metal supporting arm, R. W. Sweet. 941,591
Sheet metal working press, Norton & Krummel 941,866
Shell feeding machine, H. A. Stillwell..... 941,823
Shipping box, M. B. Claff.................. 941,438
Ships' helms mechanism for indicating and recording the movements of, Russell & Jung 941,955
Shock absorber, H. C. Turner.............. 941,594
Shoe tree, T. G. Redington 941,947
Shoe tree or form, W. H. Bayard 941,353
Shutter operator, A. Weber................. 941,899
Shutter releasing device, H. A. Tierney.... 941,592
Siding, I. S. Conover 941,358
Sifter, ash, J. S. Brown 941,613
Sign for advertising purposes, etc., changeable, Chadbourne & Simpson.......... 941,695
Silo doors, interlocking lever for, W. A. Holnagel 941,679
Sinew extractor, G. A. Congdon 941,759
Skinning and cutting tool, Wallder & Ashton 941,829
Sliding gate, F. H. Doering 941,628
Slip indicator, G. A. Johnstone............ 941,418
Smoke preventive apparatus, I. M. Sullivan. 941,547
Sodium salt of lactalbumin, making a neutral, Fischer & Bergell 941,773
Solder, aluminum, J. Wirgovits........... 941,835
Sound records, production of double faced, F. L. Capps 941,975
Speed changing device, D. O. James....... 941,925
Speed indicator governor, A. Brossmann.. 941,516
Speed mechanism, change, C. B. Elmore.. 941,506
Spike holder, H. O. Crippen............... 941,621
Spinning apparatus, transverse motion for yarn, A. E. Rhoades....... 941,648, to 941,650
Spinning machine speed changing device, McDevitt & Walton 941,645
Spokes, tenon forming machine for wheel, E. & E. E. Davis 941,625
Spool and twine holding device, H. Reicherter 941,949
Sprayer, portable, A. B. Morgan 941,528
Spring fabric, H. E. Gates 941,447
Spring fastener, F. Bowen................. 941,754
Spring wheel, C. W. Baeder............... 941,550
Sprinkler, J. W. Campbell 941,671
Stacker, pneumatic, P. Miller............. 941,583
Stacker, pneumatic straw, G. H. Bathrick. 941,606
Steam generator, J. C. Parker............. 941,462
Steam trap, J. W. Barton......... 941,846, 941,847
Steps, safety device for treads of, A. I. Davis 942,031
Stereopticon slide carrier, P. R. Hoy...... 941,712
Sterotype trimmer, C. W. Baeder 941,549
Stoker, G. Andersen 941,486
Stoker, locomotive mechanical, D. F. Crawford 941,698
Stop motion, twister, A. E. Rhoades........ 941,463
Stove, E. R. Cahoone 941,974
Stove, gas, S. H. Blodgett 941,908

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Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 10 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Further information sent on request.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry **may** be repeated.

MUNN & CO., Inc.

BUSINESS OPPORTUNITIES.

LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to get into a big paying business without capital and become independent for life. Write at once for full particulars. Address E. R. Marden, Pres., The Nat'l Co-op. Real Estate Co., Suite 378, Marden Bldg., Washington, D. C.

Inquiry No. 8918.—For manufacturers of "Wydt's Electro-Catalytic Sparking Plug."

WANTED.—Machine to manufacture a special Safety Pin (all wire). I prefer to get it made by some company in quantity lots, or on royalty. For particulars, address J. H. Reed, Lancaster, Wis.

Inquiry No. 8987.—Wanted, the manufacturers of the Van Winkle Woods & Sons, and the Weber power meters.

WILL PURCHASE COMPANIES now in operation or furnish capital for promoting franchises for gas companies, trolley, water, electric light, or natural gas, patents or other good enterprises. For information, address P. L. Gallagher, Prudential Bldg., Newark, N.J.

Inquiry No. 8996.—Wanted addresses of manufacturers of machinery for working orange wood manicure sticks.

EDUCATIONAL.

CIVIL SERVICE EMPLOYEES are paid well for easy work; examinations of all kinds soon; expert advice, sample questions and Booklet 40 describing positions and telling easiest and quickest way to secure them free. Washington Civil Service School, Washington, D. C.

Inquiry No. 8990.—For information regarding shoes not made of leather but similar to the same and are as durable.

PATENTS FOR SALE.

FOR SALE. Patent No. 900,457. An improved lathe rest for holding cylinders while being bored in an engine lathe. For further particulars address A. E. Whiting, Weston, W. Va.

Inquiry No. 9014.—For manufacturers of machinery, supplies, etc., to equip a small plant for the manufacture of iridium-tipped gold nib making for fountain pens.

FOR OUTRIGHT SALE.—U. S. Patent No. 934,238. Canadian Patent No. 120,706 agricultural implement, that will revolutionize the present methods. Most important since the Binder. Effectively whips the soil from the roots of weeds, etc., and pulverizes the soil: hence better crops, no more weeds, and less labor. Actuated by motor power and applicable from smallest gardens to largest farms. Address Nathan Tripp, Sub Station No. 9, Grand Rapids, Mich.

Inquiry No. 9016.—Wanted, machinery necessary for an installation of a plant for refining salt by a modification of the Bessemer process.

FOR SALE.

FOR SALE.—Engine lathe, swings 9½ in., takes 25 in. between centers. Complete with full set change gears to cut all size threads, 3 to 40 in. Price only $43.50. Address L. F. Grammes & Sons, Allentown, Pa.

Inquiry No. 9023.—Wanted, to buy silk machines from re-reeling, twisting, doubling, to the final process of making it into clothes.

PARTNERS WANTED.

YOUNG, energetic electrician, German, wants a partner with sufficient capital, to cover expenses of patents and models in mechanical lines for my original inventions. Write T. Roman, 495 E. 168th St, New York City.

Inquiry No. 9025.—Wanted, address of rubber manufacturers in Germany.

AN INTEREST in Patent No. 855,032 will be given a responsible firm who will manufacture and place on the market a novelty, and an improvement on a staple article for which there is a large sale. Small amount of capital would probably be needed. Partner Box 773, N.Y.

Inquiry No. 9028.—Wanted, to buy a washing machine that is run by a coil spring motor.

LISTS OF MANUFACTURERS.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9029.—Wanted, catalogues and all information on machinery for braiding straw in manufacturing straw hats.

A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9034.—For manufacturers of machinery that could reduce stumps to kindling wood.

Inquiry No. 9036.—Wanted, the address of the manufacturers of "Cycle Ball Bearing Suspenders."

Inquiry No. 9038.—Wanted, the address of the Chipman Electric Purifying Co.

Inquiry No. 9042.—Wanted the address of Farney Safety Razor Co.

Inquiry No. 9044.—Wanted to buy outfits necessary for agate polishing.

Inquiry No. 9046.—Wanted, machinery used for the manufacture of all kinds of fruit boxes, baskets and crates.

Inquiry No. 9047.—Wanted, the address of parties who install plants for making oxygen or ozone gas.

Inquiry No. 9048.—Wanted, address of manufacturers of metal table slides for extension tables.

Inquiry No. 9049.—Wanted, to buy rotary brushes suitable for a shoe shining machine.

Inquiry No. 9050.—Wanted, to buy equipment for manufacturing starch and denatured alcohol from potatoes, also manufacturers of equipments for vegetable canneries.

Inquiry No. 9051.—Wanted, to buy machinery for extraction of cotton seed oil on a small scale.

Inquiry No. 9052.—Wanted, to buy machinery, etc., for a beer plant, that manufactures beer by means of glucose.

Inquiry No. 9053.—Wanted, address of firms who install plants to manufacture nitrogen.

Inquiry No. 9054.—Wanted, address of manufacturers of articles made from mica.

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tending from Jackson Boulevard to Adams Street. The mail is thrown down chutes from the mailing platform to the platform of the subway, where the pouches are placed in the cars of the company and sent on to their destination. In the receiving of the mail at the Post Office, the pouches are unloaded from the cars onto a thirty-inch belt, which carries them up an incline to a point just below the driveway, where a cross-belt receives them and delivers them onto the mailing platform. For this work the tunnel company employs sixty-six electric motors and one hundred and fifteen cars. During the year 1907, the electric mail trains made 337,060 trips and carried 10,059,567 bags, pouches, and packages of mail, with a record of 99.51 per cent perfect as regards the time of delivery at the various tunnel stations. On the day before Christmas of that year, the tunnels handled over 50,000 bags, pouches, and packages, which were transported in 1,391 cars and in 1,229 trips.

It can be readily understood that a complicated transportation system such as this, involving an enormous number of cross-overs and switches, demanded for its safe and uninterrupted operation a very complete system of signaling. The method adopted is what is known as the Stolken train-signaling system, the invention of Mr. J. J. Stolt and Mr. W. J. C. Kenyon, the vice-president of the tunnel company. Limitations of space prevent any detailed description, but in brief the system may be described as one which does not employ track circuits, but which embodies two distinctive adaptations; first, the absolute protection of an intersection of two tracks, and secondly, the maintenance of a signal or alarm for a definite time after a circuit closer has been actuated. The method is automatic. For the protection of an intersection of tracks, on each of which there is traffic in only one direction, red signal lamps are employed, which are lighted by an approaching train. These lights are so placed that warning is given to a train on the other track and to any train which may be approaching from the rear. After the train has set the warning signals, it crosses the intersection, and as it passes on restores all the signals to the "clear" or no signal condition. In addition to the red lamps, a green lamp is provided on each track, which indicates to the motorman of an approaching train that his signals are working properly, and so gives him permission to go ahead.