Aluminum stands fourth, being preceded only by silver, copper and gold as a conductor of heat as well as electricity. . . . The electrical conductivity of a standard section of pure silver being taken at 100, an equal section of copper also at 100, pure gold at 78.0, an equal section of pure annealed aluminum bas an electrical conductivity of about 54.20.

This relatively high electrical conductivity when equal weights are taken will undoubtedly prove a factor of importance in developing electrical uses for aluminum.

The electrical conductivity of aluminum is increased fully 5 per cent. by carefully annealing even the ordinary soft wire, and with hard drawn wire the conductivity is increased by annealing nearly 10 per cent. Pure aluminum has no polarity, and indeed the commercial metal in the market is practically non-magnetic.

Pure aluminum, when properly treated, is a very malleable and ductile metal. It stands third in the order of malleability, being exceeded only by gold and silver; and in the order of ductility seventh, being exceeded by gold, silver, platinum, iron, soft steel and copper. Both malleability and ductility are greatly impaired by the presence of the two common impurities, silicon and iron.

Aluminum can be rolled or hammered cold, but the metal is most malleable at, and should be heated to, between 350° and 400° Fahr., for rolling or breaking down from the ingot to the best advantage. Like silver and gold, aluminum bas to be frequently annealed, as it hardens up remarkably upon working. In consequence of this phenomenon of hardening during rolling, forging, stamping or drawing, the metal may be turned out very rigid in finished shape, so that it will answer excellently well for purposes where the annealed metal would be entirely too soft, or too weak, or lacking in rigidity to answer. Especially is this true with aluminum alloyed with a small percentage of titanium, copper or silicon. It can be safely stated, as a general rule, that under similar conditions, the purer the aluminum the softer and less rigid it is.

The very remarkable results that have been obtained with aluminum bronzes and with aluminum Babbitt for bearings were pointed out. These may also be found in the paper before cited. Mr. Hunt closed his lecture with a brief account of a dozen or more curious and useful alloys that have been discovered by different investigators which indicate some of the probable uses of the metal and which show how carefully this field of investigation is being worked.

Adirondack & St. Lawrence Compound Mogul Locomotive.

The Schenectady Locomotive Works has recently built three compound mogul freight engines for the Adirondack & St. Lawrence road, of the design shown by the accompanying illustration made from a photograph. The general dimensions of these engines are as follows:

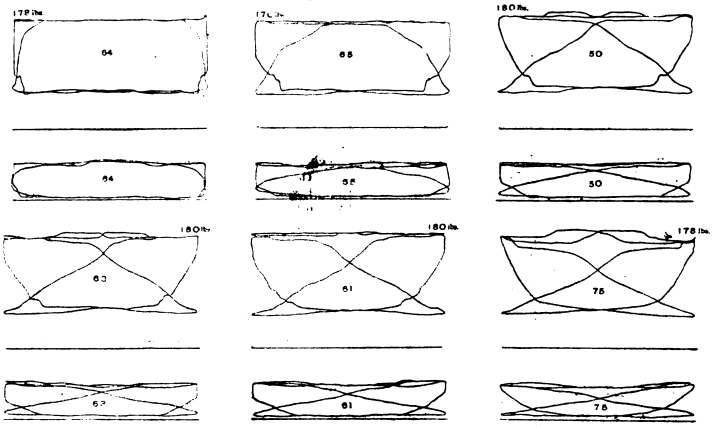
Cylinders, 20 and 32½ in. × 26 in.
Drivers, diameter, 57 in.
Boiler, wagon top, diameter at front end, 58 in.
Firebox, 102 in. × 42⅛ in.
Tubes, number, 268.
Do., diameter, 2 in.
Do., length, 11 ft. 6 in.
Boiler pressure, per sq. in., 180 lbs.
Driving axle journals, 8in. × 9 in.
Engine truck axle journals, 6 in. × 10 in.
Tender axle journals, 4¼ in. × 8 in.
Weight on drivers, 111,500 lbs.
Weight on truck, 18,000 lbs.
Total weight, 132,500 lbs.
Travel of valves, 6¼ in.
Outside lap of valves, 1¼ in.
Inside clearance of valves, high pressure, 1/16 in. each side.
Inside clearance of valves, low pressure, 1/16 in. each side.

The capacity of the tender is 4,000 gallons of water and eight tons of coal. We give some indicator cards taken from one of these engines when hauling 55 loaded freight cars on the New York Central & Hudson River road. The engine hauling this train steamed freely with a 5 in. exhaust nozzle. The following table gives the data from the indicator cards:

No. of card.	Rev. per minute	Piston speed in feet per minute.	Miles per hour.	Point of cut-off in inches. H. P.	Point of cut-off in inches. L. P.	Horse power.	Per c. of work done in L. P. cylinder.
64	40	173.3	6.78	21⅞	22¼	367.7	52.53
65	72	312	12.2	17	18¼	528.1	50.17
50	104	450.6	17.63	13⅜	15¼	637.5	51.54
63	108	468	18.31	12	13¼	609.3	51.21
61	101	450.6	17.63	1-3/4	12⅜	547.7	52.43
75	192	832	32.55	10¾	12⅜	802.8	51.35

These diagrams are the best that have been published from a two-cylinder compound in this country. The combined diagrams show an economical use of steam such as could not be obtained in any kind of single expansion engine that it would be practical to make. The cards show the effect of inside clearance at low speeds, and in this way are instructive, as many have hesitated to use inside clearance on simple engines, fearing uneconomical results. The contrary is shown by card No. 75, where the speed is such that the transfer of steam from one end of the cylinder to the other, so clearly shown in cards Nos. 63, 64 and 65, has been reduced to such a small amount that it does not effect the indicator perceptibly. The improvement in the compression line on card No. 75 by the use of an inside clearance is worth attention. To cut out the inside of a slide valve is a decided advantage on a simple engine, even at moderate speeds, and an important and necessary step to take for a high speed engine, as shown by the admirable indicator cards from the Reading engine which we published recently.

It is evident from these indicator cards that the two-cylinder compound engine is now beginning to receive the careful designing and proportioning which it so well deserves.



INDICATOR DIAGRAMS TAKEN FROM SCHENECTADY MOGUL LOCOMOTIVE.

The figures at the upper corners show the boiler pressure.

Block Signaling Apparatus on the Chicago, Milwaukee & St. Paul.

As our readers may remember, the signaling of trains, so as to keep them a station apart, is done by the station operators on the Chicago and Council Bluffs Division of the above-named road by means of Morse circuits, arranged somewhat differently from those usually employed. The sounders are worked directly, without relays, and are so arranged that they can be made extra loud, when desirable, for the benefit of operators whose duties often call them outside the office. We give below the substance of the rules under which these circuits are operated.

The normal condition of the "block wire" is a circuit from any one station to the next station east or west. Sounders of 25 ohms each are used where distances do not exceed eight miles between stations. Two cells of battery per mile is the usual rule. The operator places his key on the west side of the ground switch when signaling ahead for east bound trains, and on the east side when signaling ahead for west bound trains. There are two sounders, one key and one ground switch at each station, except terminals, and batteries at each alternate station The ground switches are kept turned to the west side of the key by means of a spring, because more work is done east than west.

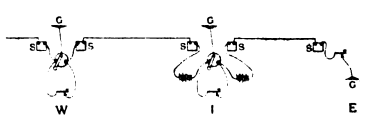


Fig. 1—C., M. & St. P. Ry. Block Signal Circuits.

No business except that pertaining to the blocking of trains may be done on this wire. The operator must always bear on the ground switch turned on either the west or the east side (except when working with the stations east and west at the same time), thus preventing signals reaching a station not interested in the business being done. Operators will then understand that any signals they hear on "block" instruments are intended for them, and that such signals must receive attention *at once*.

When reporting a train the operator must hold the ground switch between the two points, call each office three times, sign his call and report; then close the ground switch at once to enable him to receive O.K. from both directions. If O.K. is not received he must call each office until he gets it, and must then report again.

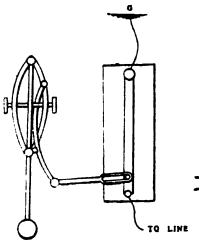


Fig. 2—Ground Switch.

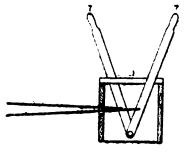


Fig. 3—Signal Levers.

To aid the operator in surely putting on the ground wire, after sending a report, the ground switch, fig. 2, has been devised and is used in some of the offices. This, it will be seen, is connected with the key in such a way that throwing the switch off opens the key, and closing the key puts the ground on again; while, so long as the ground is on, the key may be worked in the usual manner.

Fig. 4 shows an arrangement of circuits connected with the signal levers, which has been devised and patented by C. E. Buzzell, an operator at one of the stations on the line, for the purpose of sounding a continuous alarm on the sounders during the time that a semaphore is held down to admit a train to a section. The lower parallelogram represents the under surface of the cover of a box inclosing the lower parts of two vertical levers for operating the semaphores (box and levers shown in fig. 3). These levers are placed inside the telegraph office, and they project through slots, 6, in the top of this box.

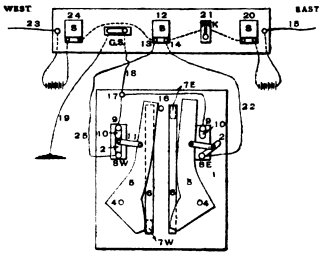


Fig. 4—Buzzell's Safety Device

The position of the lever for the eastern signal is represented by 7 *E* and that of the western signal by 7 *W*; 5, 5 represent rocker arms fastened to the under side of the covers of the box by pivots, 4, 4, in such a way that, as will be seen, the movement of the signal levers opens or closes the switches 2, 2, controlling the currents through wires 22 and 25. When lever 7 *E* is moved to its opposite position (to the other end of the slot) it closes the switch on the east side, and in like manner the movement of 7 *W* to the other end of the slot opens the switch in wire 25. In the figure, the circuit from the east, wire 15, is broken at 8 *E*. The circuit from the Western wire, 23, goes to ground through 13, 25, 8 *W*, 17, 18 and 19. The breaking of the eastern circuit at 8 *E* throws the current through the automatic circuit breaker at 14, then through 13, 25, 17, to ground, and, the circuit breaker, or "buzzer," being now in circuit, there is a continuous alarm, thus warning the operator that the signal 7 *E* is down for admitting a train to the section. The western circuit, 23, operates in the same manner. If both switches, 2, 2, are open at the same time, the ground wire is entirely cut off and circuits 23 and 15 are connected together directly through the buzzer, 12, thus giving an alarm at the home office and at the stations in both directions.

By this apparatus an operator who disregards the rule requiring him to *hold* the semaphore down (instead of fastening it) and goes off about other work is reminded of what he has done, as long as he is within hearing of the buzzer or automatic sounder. Every time a train is admitted to a section the buzzer vibrates as long as the signal is down, so that the operator at the other end of the section has a special warning showing him (in all probability) the exact time that the train enters, and reminding him that he must not admit a train moving in the opposite direction (the road is single track). And if an operator, say at *A*, should blunder and admit a train to the section *A B* before he had received the consent of *B*, his action in pulling down the semaphore would at once notify *B* and quite likely give him time to correct any dangerous error on *A's* part.

Ore Dock Contract.

The Duluth & Winnipeg has let the contract for building ore docks at the mouth of the Nemadgi River, on Allouez Bay, Superior, Wis., to Grant, Foley Brothers & Guthrie, of St. Paul. These docks will be used jointly by the Duluth & Winnepeg and the Duluth, Messabe & Northern.