

THE

83784

Electrical Engineer.

A Weekly Review

OF

Theoretical and Applied Electricity.

VOLUME XVII.—1894.

(January to June.)

NEW YORK:
The Electrical Engineer,
208 Broadway.

	PAGE.
Railway and illuminating plant of the Milwaukee Street Railway Co. Otto Frick.....	A 285, 247, 274, 280
Railways, Chloride accumulator on Paris.....	A 51
" Conduit.....	E 58
" Electric in country districts.....	F 495
" in New York City, Electric.....	N 438
" Nashville.....	N 10
" New trolley roads.....	N 10
" Should electric supply power to individuals.....	E 236
" and electrolysis.....	E 374
" and electrolysis.....	E 475
Rapid transit, New York's hope of <i>Recent Progress Nalle Applications</i> Dele <i>Electricity</i> By R. Ferrini.....	440
Recording wattmeter for arc circuits Thomson.....	PT N 243
" Records for the benefit of printers.....	L N 118
Reed induction system in telegraphy.....	A 3
<i>Reference Book of Tables and Formulas for Electric Street Railway Engineers.</i> By E. A. Merrill.....	R 399
Reflectors, Gleason's.....	PT N 123
" Paragon.....	PT N 314
Relative advantages of toothed and smooth core armatures.....	A 459
" economy of copper in single phase, two phase and three phase transmission.....	A 42
Relay, Weston telegraph.....	A 157
Report of Board of Mass. Railroad Commissioners.....	R 399
" of the General Electric Company.....	N 330
Resonance as related to the transmission of energy, Electrical. W. A. Anthony.....	A 545
" " Lighting by.....	A 499, L 517
Resonating conductors.....	E 454
" for telegraphy and telephony. Pupin's system.....	A 448
Reveratory furnace with movable electrodes N	548
Review of the progress of the American Institute of Electrical Engineers.....	A 452
Revolution counter, May's.....	PT N 478
Rhodhamal, J. H.....	N 201
Richardson, Wm. (nbtuary).....	55
Ricks' decision, Judge.....	T N 108
Ries Electric Specialty Co.....	T N 195
" & Scott alternating motor.....	A 438
Riedon Iron & Locomotive Works.....	T N 289
Roberts Correspondence School of Technology.....	N 37
Rollason wind motor for electric lighting.....	A 409
Rose Polytechnic Institute.....	N 444, 499
Roland, Prof. vs. The Cataract Construction Co.....	L N 55, 76
Rosland's method of cooling transformers and conductors.....	N 128
Royal Electric Co.....	T N 167, 542
Rules for electrical construction and operation.....	301
" <i>Electricity Works Management.</i> By Albert Gay.....	R 165
" " N. E. L. A. standard.....	N 320
Bushmore drum armature winding.....	PT N 368

S

	PAGE.
Sachs, J.....	N 513
St. Clair tunnel, Kerite cables in.....	PT N 170
St. Louis Iron & Machine Works.....	T N 443
Staladin's electric furnace.....	N 20
Sanson cord.....	T N 221, 445
Sanitation in France, Hermite process.....	A 497
Sarrent-Poor (Married).....	540
Saurer petroleum engine, H. C. Oushing, Jr.....	A 205
Schloss, N. L.....	N 119
School of Electricity, National.....	N 439
" Technology, Roberts Correspondence.....	N 37
Schuyler Electric Co. vs. Electrical Engineering & Supply Co.....	L N 263
Screens for electric and other apparatus, transparent conducting.....	A 417
Search light for Sandy Hook.....	N 60, 394
Schriber automatic switch.....	PT N 169
Self induction and bi-metallic telephone wires. A. N. Mansfield.....	A 65
Service of good will for the electrical fraternity.....	L 165
Shapleigh cut-out not infringed.....	L N 500
Shaver telephone patents, Sale of.....	N 522
Shawhan multipolar generator.....	PT N 463
Shear, Bliss automatic truck bar.....	PT N 443
Sheehy electric block signal.....	A 189
Sheffield Laboratory.....	N 489
Shipping Manufacturers List.....	T N 108
Short and Brush annual meetings.....	N 311
Should electric railways supply power to individuals.....	E 235
Shunts Grooved cable rawhide belting.....	PT N 543
Siemens, Alexander.....	N 11
" on the Pyramids.....	N 425
Sign of the Times.....	E 185
Signals and trolley currents.....	N 333
Silvery storage car system.....	A 208
Single motor equipment for street railways, Card.....	A 496
Single-phase circuits, Motors operated by.....	A 4, R 12
Sioux City Traction Co.....	N 498
Small arc lamps.....	E 308
" Elihu Thomson.....	A 270
" arcs and electrical business methods.....	L 307
" " or large incandescents. Albert Schelble.....	A 385
" " or subdivided arc lights.....	A 261
Smith & Co., Ltd.....	T N 423
Snow plow, Taunton electric.....	PT N 123
Soldering stick, Allen.....	T N 325
Southern New England Telephone Co.....	T N 147
" notes.....	394, 543

T

	PAGE.
Spark arrester, Chicago.....	PT N 423
Specific electrostatic capacity and specific other density, Probability of identity between.....	E 269
J. Houston and A. E. Kennelly.....	A 269
Specific inductive capacity of solids under either slowly or rapidly changing fields.....	N 537
Speed of electric cars.....	E 114
" recorder for electric cars, Henry L. 105.....	A 233
" " Moore.....	A 180
Spencer, E. J.....	N 301
St. Louis notes.....	N 343
Standard Electric Co.'s alternating system.....	PT N 189
" multipolar generator.....	A 189
" rules for electrical construction and operation.....	301
" Tables for Electric Wiremen. By Chas. M. Davis.....	R 320
" Underground Cable Co., report.....	N 56
Standardizing electrical measuring instruments.....	A 516
Stanford University.....	N 439
Stanley Electric Co.'s new two-phase alternating apparatus.....	A 505
Star ventilator, Infringement of.....	T N 147
Station construction, Arnold system.....	A 436
" instruments, Essential.....	A 163
" of the Edison Electric Illuminating Co. of Brooklyn.....	E 133, L 101, 102
Statistical Association, National.....	R 70
Stealing current in New York.....	N 188
Steam heating, Exhaust.....	N 463
" Progress of. I. H. Babcock.....	A 205
" " plant at Scranton.....	T N 443
Steel motor Co.....	T N 30
Steering by telephone in a fog.....	N 321
Stevenson's system of communication with lightships.....	A 492
Stevinger, L.....	N 359
Storage battery..... (see also Accumulator)	E 203
" Central station.....	N 193, L 241, 260, 275
" " challenge.....	W. W. Donaldson, L 271
" " controversy-Gibbs-Bracken, L 219	
" " fighting on the Chesapeake & Ohio E. R.....	N 439
" " litigation.....	L N 144, 191, 517
" " Consolidated Electric Storage Co. vs. Electric Storage Battery Co.....	L N 432
" " on a drawbridge at Omaha.....	A 140
" " testing.....	L 440
" " " E. McG. Lloyd.....	A 266
" " " traction at Berea, Ohio.....	A 34
" " batteries for central stations, power plants and large isolated installations.....	A 190
" " " in central stations.....	E 132
" " " in the central station of the Edison Electric Illuminating Co. of Boston. A. C. Shaw.....	A 308
" " " car system, Silvery.....	A 235
Storm, effects of.....	N 151
Street cars with buttons.....	N 479
<i>railway motors</i> , by Herman Haupt.....	E 263
Subdivision and distribution of artificial sources of illumination.....	A 450
Subways, London.....	N 489
Swan Lamp Co.....	N 104
Swedish charcoal iron for armatures and transformers.....	T N 146
Switch, Central Electric main line.....	PT N 183
" contacts and brakes, Design of.....	N 94
" Electric Appliance Co.'s new electric light.....	PT N 58
" " Newton fixture arm.....	PT N 443
" " patent litigation.....	L N 144
" " Perkins patent not controlling.....	L N 302
" " Schriber.....	PT N 169
" " Standard push.....	PT N 19
" " Stevens' finish.....	PT N 223
Switchboard, National Telephone Co.'s.....	PT N 171
" General Electric.....	PT N 441
Switches, Gibbs.....	PT N 266
" Hill.....	PT N 422
Switching dynamos in parallel, Brenner's one voltmeter method.....	A 150
" " in parallel, One voltmeter method.....	L 261
Synchronizer for alternating machines, acoustic.....	PT N 59
" and phase indicator, Optical.....	A 513

Tabernacle, Brooklyn.....	N 435
Tachometers, Queen & Co.'s.....	T N 18
Taftville, Three phase transmission plant.....	A 398
Tanning, Electric.....	N 537
Taunton electric snow plow.....	PT N 123
Tausnik's electric smelting process.....	N 536
Taxation by free passes.....	E 13
Taxing telegraph poles in Alabama.....	L N 539
Telanograph.....	N 539
Telegraph-1844-1894.....	E 454
" Joseph Henry's place in the history of the electro-magnetic. Mary A. Henry.....	A 1, 26, 61, 84, 107, 123, 150, 206, 312, 363, 368, 407
" " Jubilee of the American.....	A 445
" " line, Pan-American.....	N 157
" " line, African.....	N 164
" " relay, Weston.....	A 157
Telegraphy, Central Asia.....	N 530
Telegraphy by electrical resonance, Pupin's system.....	A 509
" Reed induction system.....	A 3
" " and Telephony in America.....	E 134
" " " Pupin's system of resonating conductors.....	A 448

Telephone, Competitive service for Brooklyn.....	N 537
" Another inventor of.....	N 541
" attachment, Weber.....	PT N 78
" Company, Groff.....	L N 539
" " Mercantile Electric.....	T N 463
" conductors, Bi-metallic. A. E. Kennelly.....	A 108
" " " and their relation to resonance on long distance circuits. F. W. Dunbar.....	A 81
" conductors, Bi-metallic, wires for.....	A 23
" Construction Co., Western.....	PT N 301
" Drawbaugh transmitter issued.....	F N 301
" Fourteenth report of the American Ball Co.....	N 308
" Government suit to annul the Patent.....	L N 351
" Hamilton International.....	PT N 74
" in Germany.....	N 74
" Merceder and Ansan microphone reducer.....	A 330
" National Co.'s new system of complete metallic circuits.....	PT N 171
" Ness automatic warehouse.....	PT N 27
" Exchange, New Broad Street, New York.....	A 23
" New Year greetings by.....	N 69
" outfit, Ingersoll "Peerless".....	PT N 323
" outfits of the Manhattan Electrical Supply Co.....	PT N 18
" patent, Berliner.....	E 16
" " situation.....	A 44, 63, 93, 105, 120
" " " (erratum).....	E 51
" patents, American Bell.....	N 523
" " Sale of Shaver.....	E 474
" rates, New basis.....	N 194
" receiver attachment, Cooke pneumatic.....	PT N 174
" " Bevil of the Drawbaugh.....	N 76
" " service at message rates.....	A 439
" " Steering by. In a fog.....	N 321
" " switchboard, National.....	PT N 360
" " " troubles, locating, J. W. Mansson.....	A 153
" " The. By E. L. Webb.....	N 518
" " transmitter, Cook extension.....	PT N 392
" " transmitters, Non-infringing.....	L 144
" " Western Construction Co.'s apparatus.....	PT N 223
" wires, Self-induction and bi-metallic. A. N. Mansfield.....	A 65
" " work in New York city, cost of.....	A 26
" " and telegraph.....	E 335
Telephones, Bacteria in.....	E 335
" cheap in Frisco, N. S.....	N 118
" in Australia, private.....	E 43
Telephony, bi-metallic wires in.....	N 513
" in Kansas City, Long distance.....	N 513
" limitations to long distance, F. W. Dunbar.....	A 23
" and telegraphy, Pupin's system of resonating conductors.....	A 448
Tell-tale for circuit breakers.....	A 335
Terry, F. S.....	N 119
Terry's Island power scheme.....	N 573
Tesla, Nikola.....	N 576, 540
" condenser magnet.....	A 37
" " electrical oscillator.....	A 21, E 30
" " high potential conductor.....	A 132
" " motors operated from single phase two-wire alternating circuits.....	A 4
" " single circuit alternating motor.....	P N 55
Tesla's automatic fluid interrupter for producing high frequency currents.....	A 133
Test of Mather apparatus in Philadelphia.....	A 530
Testing for grounds on incandescent circuits.....	A 391
" A. S. Hatch.....	PT N 39
" " see, Home portable.....	PT N 291
" " Chicago "Inspector's".....	PT N 291
Text book of <i>Dynamic Magnetism and the Construction of Dynamos</i> . By D. C. Jackson.....	R 237
Theater lighting, Utopia, Limited.....	A 418
Therapeutics, Electricity in relation to.....	N 346
Theory and design of the closed coil constant current dynamo.....	A 73, 95, 113
Thofers apparatus for electro-deposition.....	N 519
Thomson arc lamp for incandescent and variable circuits.....	PT N 224
" recording arc wattmeter.....	N 339
" " wattmeter for arc circuits.....	PT N 243
" " for street car testing.....	PT N 267
" Houston Co. vs. Western Electric Co.....	L N 517
Three-phase transmission plant at Columbia, S. C.....	A 409, 419
" " at Taftville, Conn.....	A 398
" " " wire plant, Adaptability of an Edison Jan. Millie.....	A 177
" " " trolley system at Portland, Ore.....	A 473
Tides, Electrical utilization of the Irish Sea.....	A 62
Time recorder, Autograph.....	PT N 463
Toledo, Monroe & Detroit Electric Railway.....	N 549
Toronto electric lighting.....	N 495
<i>Traction electrica sistema de Love</i>	E 513
Train lighting system, Poole & White electric.....	10
<i>Traité de Télégraphie Electrique</i> . By H. Thomas.....	E 518
Transfers, Identifying.....	N 549
" in Cleveland.....	N 135
Transformer, Packard.....	PT N 56
Transformers, Air-core.....	L 361
" Dr. Pupin on the behavior of air-core.....	L 265
" " Economic use of.....	A 97
" " Economy in the use of.....	A 113
Transmission at Columbia, S. C., Triphase.....	A 409, 419

	PAGE.
Transmission Economic limits of Niagara water power.....	A 468
" in France, Electric power.....	N 475
" in Milwaukee, Electrical.....	N 451
" of energy, Electrical resonance as related to, W. A. Anthony.....	A 545
" of Niagara's power, C. E. Emery.....	A 449
" " water power by electricity, E. J. Houston & A. E. Kennelly.....	A 385
" " Niagara's water power by electricity.....	A 467, 491
" " power at Austin, Texas.....	Ax, 439
" " by electricity, Conditions of economy in long distance.....	A 466
" " " from Niagara Falls, Electrical.....	Ax, 14, 84, 58, 73, 94, 112, 139, 566
" " " in Belgium, electric.....	N 188
" " " in India, proposed electrical.....	A 425
" " " in Italy.....	A 425
" " " Westinghouse plans for Niagara.....	A 35
" " proposed in California.....	N 284
" " plant at Columbia, S. C., Three phase.....	A 403
" " at Taftville, Conn., Three phase.....	A 398
" " Polyphase.....	Ax, 295, 354
" " Relative economy of copper in single phase, two phase and three phase, W. L. R. Emmet.....	A 42
Transmissions <i>Electrica del Lavoro Meccanico</i> , By G. Sartori.....	B 411
Transparent conducting screens for electric and other apparatus.....	Ax 417
Transportation department, Electric.....	A, 33, 45, 68, 109, 126, 160, 179, 220, 263, 261, 292, 322, 414, 432, 478, 496, 531, 549
Triphase power transmission at Columbia, S. C.....	A 402, 419
" " Triumph " iron-clad dynamo.....	T N 514
Trolley clamp, "Chicago,".....	T N 515
" " current, How to make it "deadly,".....	N 429
" " currents and railroad signals.....	N 553
" " Dangers of.....	E 515
" " extension in Brooklyn.....	N 549
" " in Chicago.....	N 933
" " line regulation for Brooklyn.....	N 69
" " overhead circuits.....	E 494
" " Popularity of.....	E 337
" " Three-wire system at Portland, Ore.....	Ax 478
Truck, Graham "electric".....	T N 87
Tudor storage batteries in the central station of the Edison Electric Illuminating Co. of Boston, A. C. Shaw.....	A 238
Turpin Electric war chariot.....	N 511
Twenty-fifth Annual Report of the Board of Mass. Railroad Commissioners.....	B 370
Two-phase apparatus, Stanley Electric Co.....	A 505
U	
Underground railway wires in Kentucky.....	L N 118
" " rapid transit for New York.....	E 71
" " wires in St. Louis.....	T N 143
Underwriters and electricity.....	E 484
" " insulation requirements and their influence on quality of wires, H. C. Cushing, Jr.....	A 239
Union Pacific wires.....	N 117
Unipolar dynamos for electric light and power.....	Ax 468
" " machines.....	E 474
Unit magnitude, New prefixes proposed, E. J. Houston and A. E. Kennelly.....	A 801
United Columbian Electric Co.....	T N 40
" " Electric Improvement Co.....	T N 325
Universal shunt box for galvanometers.....	Ax 324
University Extension Course.....	N 145, 165, 233
" " lectures, to electrical workers.....	N 36
" " of Minnesota.....	N 208
" " of Wisconsin.....	N 430
Unknown causes of fire, H. C. Cushing, Jr.....	A 410
V	
Vail, Mrs. Alfred (obituary).....	121
Vallee Bros. & Co.....	T N 536
Van Choate pronunciation.....	L N 530
Van Nuis on the Peacock volt distributor.....	L 143

	PAGE.
Van Vleck 8000 H. P. engine.....	A 89
Voltmeters for direct and alternating currents, Acme standard.....	T N 194
W	
Waddell-Ents Co., Embarrassment of.....	N 166
Wagner Electric Mfg. Co.....	T N 59
" " H. A.....	N 16
Wagon, electrical advertising.....	T N 423
Walke & Bartlett.....	T N 313
Walker Mfg. Co.....	T N 80
" " " Street railway apparatus of.....	A 309
Wallace Electric Co.....	T N 80
Warren alternate current engine-dynamo.....	A 361
Water power plant of the Concord Land & Water Power Co., A. C. Shaw.....	A 370
Wattmeter, Bristol's Recording.....	T N 503
" " for arc circuits, Thomson Recording.....	T N 248
" " for street car testing, Thomson Recording.....	T N 267
" " Thomson recording arc.....	N 329
Weber telephone attachment.....	T N 79
Webster separators, World's Fair test.....	T N 168
" & Co., Warren.....	T N 284
Weight of electric motors.....	L 517
Welbachs and arcs, Comparison between.....	N 525
Wemple-Pope (married).....	N 56
Wemela, E. J.....	N 501
Western notes.....	T N 40, 60, 104, 124, 148, 172, 244, 267, 293, 316, 326, 364, 384, 424, 444, 484, 504, 524, 544
" " Telephone Construction Co.....	T N 19
" " Union a common carrier.....	L N 118
" " A poor quarter for.....	N 949
Westinghouse annual report.....	A 438
" " Co. and the Niagara contract.....	A 438
" " combined direct and alternating current generator at Rochester, N. Y. John Dennis, Jr.....	A 245
" " direct current arc generator.....	T N 225
" " Electric & Mfg. Co.....	T N 421
" " Machine Co., Ownership of.....	T N 56
" " motors for Boston West End.....	N 233
" " plans for Niagara contract.....	A 365
" " railway motors and controller.....	A 266
" " report.....	E 435
Weston engines.....	T N 459
" " telegraph relay.....	A 157
West Virginia University, Electrical apparatus wanted.....	T N 423
What are wiring rules made for?.....	L 230
Wheeler, E. S.....	N 329
White, A. C. (Obituary).....	37
" & Co., J. G.....	T N 146
" " & Middleton gas engine.....	T N 168
" " adjustable lamp holder.....	T N 314
" " Crosby Co.....	N 252
Why prices for electrical street lighting are reduced.....	L 225
Wimshurst machine without sectors.....	A 409
Wind motor for electric lighting, Rollason.....	A 400
" " power, prize for information on.....	N 307
Windmill plants, Electric.....	E 90
Windmills, Lewis system of electric lighting.....	A 86
Winkler twin series motor.....	A 9, 181
Wire, Test of Ideal.....	T N 243
Wires ordered down, Boston overhead.....	N 533
" " Self induction and bi-metallic telephone, A. N. Mansfield.....	A 65
" " Underwriters insulation requirements and their influence on the quality of, H. C. Cushing, Jr.....	A 239
Wiring appliances, General Electric.....	T N 423
" " rules, What are they made for?.....	L 230
Woodbury, C. J. H.....	N 513
World's Fair electric lighting, at the New York Electrical Society.....	N 223, 293
Wortherpoon & Evans.....	T N 542
Woven wire brushes.....	L 517, 530
Y	
Young Men's Institute, Electricity at.....	N 165

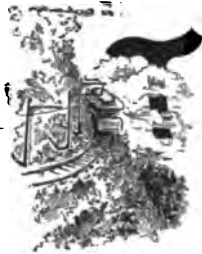
AUTHORS.

Adams, A. D.....	459
Anthony, W. A.....	269, 261, 317, 339, 418, 466, 450, 549
Ayrton, W. E.....	324, 417
Babcock, I. H.....	236
Baker, E. J.....	549
Balch, A. C.....	478
Barstow, W. S.....	269
Bedell, F.....	261, 513

	PAGE.
Benjamin, G. H.....	16
Bergmann, S.....	284
Berry, T. H.....	155
Bracke, Wm.....	191, 241
Brooks, Morgan.....	165
Brown, J. S.....	253
Burton, G. D.....	73
Caboon, J. B.....	198, 491
Candfield, M. C.....	377
Carhart, H. S.....	72, 90, 113
Crober, A. C.....	261
Crocker, F. B.....	468
Cushing, H. C., Jr.....	229, 306, 410
Debell, E. L.....	141
Dennis, J. Jr.....	245
Donaldson, W. W.....	371
Dunbar, F. W.....	23, 65, 90
Duncan, Louis.....	423
Edson, J. B.....	267
Emery, C. E.....	449, 510
Emmet, W. L. E.....	43, 467
Ewing, J. A.....	417
Ewing, T., Jr.....	304
Farnham, I. H.....	373, 396
Foot, A. E.....	163, 296, 536
Forbes, Geo.....	14, 34
Frick, Otto.....	225, 247, 374
Genung, N. H.....	325
Gibbs, W. W.....	163, 219, 366
Green, E. C.....	371
Hadaway, W. S., Jr.....	197, 476
Hale, E. S.....	495
Harrington, W. E.....	190
Hatch, A. S.....	361
Henry, J. C.....	165, 371
Henry, Mary A.....	1, 26, 61, 84, 107, 123, 150, 266, 318, 368, 368, 407
Herriek, A. B.....	460, 530
Highlands, E. M.....	533
Houston, E. J.....	200, 269, 296, 301, 325, 452, 467, 480, 491, 511
Howard, L. E.....	364
Jackson, D. O.....	163, 423
Kennelly, A. E.....	103, 260, 289, 301, 325, 467, 480, 491, 511
Kintner, C. J.....	357
Klaassen, Helen G.....	417
Law, M. D.....	179
Leonard, H. W.....	491
Lloyd, R. McA.....	241, 366
Lodian, W.....	68
Mansfield, A. N.....	65
Mansfield, F.....	479
Manson, J. W.....	153
Marks, L. B.....	329
Mather, T.....	394, 417
McFadden, P. J.....	113
Merrill, E. A.....	231
Milne, Jas.....	177
Moler, G. S.....	512
Moore, D. McF.....	180
Mott, M. I.....	513
Oshner, E.....	492
Parnly, O. H.....	468
Perkins, A. H.....	533
Pope, F. L.....	263
Potter, W. B.....	511
Pupin, M. J.....	365
Reed, C. J.....	373
Roberts, L. L.....	41
Rittenhouse, C. F.....	468
Robinson, F. G.....	277
Sachs, J.....	162
Scheffler, F. A.....	254
Scheible, Albert.....	365
Schoop, Paul.....	67, 90, 114, 156, 178, 223
Scott, C. F.....	254
Seymour, J. H.....	307
Shaw, A. C.....	270, 293, 455
Smith, Gerritt.....	371
Stanley, L. T.....	199
Stanley, Wm. Jr.....	125
Steinmetz, Chas. P.....	153, 430
Stewart, W. N.....	141, 191
Thayer, G. L.....	317
Thom, H. C.....	164
Thompson, E. P.....	311
Thomson, Elhu.....	11, 270
Turbayne, W. A.....	144
Vail, J. H.....	190, 339
Van Nuis, C. S.....	143, 362, 495
Widmayer, F. B.....	365
Willyoung, E. G.....	516
Wilson, Fremont.....	261
Worlin, W.....	517
Wurts, A. J.....	458, 473

ELECTRIC TRANSPORTATION DEPARTMENT.

FROM STRAWBERRIES TO SNOW BY THE MOUNT LOWE ELECTRIC ROAD.



HE electrical engineer who is fortunate enough this Spring to visit the California Midwinter Fair is likely to enhance the pleasure of his westward journey by a trip into Southern California. Should he do this, as many another tourist has already done before him, he will discover that the attractions of the Los Angeles region have been greatly added to in a manner that will appeal to him not less from the technical than from the æsthetic standpoint. Some nine miles from Los Angeles, and nestling at the feet of the Sierra Madre range, is the young and beautiful city of Pasadena, which has gathered itself into the lap of the hoary mountain very much as the fair Shunnamite cherished old King David. Of course the city is ornate with orange groves and flower gardens; that we all expect of even the small-

all and above all tower the dark slopes of the mountains crested with snow at this season of the year, and the greatest charm of Pasadena is that through the energy of a leading citizen, Prof. T. S. C. Lowe, and with the help of electricity, the summits of the range



FOOT OF GREAT CABLE INCLINE OPERATED BY ELECTRIC MOTOR, MT. LOWE RAILWAY.

est and least ambitious South California community; but one is hardly prepared for such a wealth of it or for so many evidences of substantial prosperity in the more utilitarian forms of brick and mortar, paved streets, opera house blocks and the latest styles in dry goods. Back of



JUNCTION OF TROLLEY SYSTEM AND CABLE ROAD.

have been made easily accessible. From Mount Lowe, an altitude of 6,000 feet, or even from Echo Mountain, 3,500 feet high, we command a view of extreme beauty, with snow capped mountains for a background; deep green valleys right and left—the San Gabriel, the San Fernando and others; and far away, across thirty miles of poppy field, calla lily beds, and fruit orchards, the Pacific Ocean. If it were night, we could see the distant rows of white arcs in the streets of Los Angeles, and the flash of the light house on the island of Santa Catalina, 60 miles away. Prof. Lowe, in a most ingenious and original manner has built a combined electric and cable road, opening up to travel this region of airy enchantment. Switzerland has lately seen something of the kind attempted in the electric road which runs in sight of the Jungfrau to the new Lauterbrunnen hotel from the top of the cable road, out of the valley; but Prof. Lowe starts from the Pasadena Valley with an electric road operated by gas engines; then operates a section of steep cable road by electric motor energized from the same power plant; and at the end of that has another electric road. The features of such a piece of engineering are, as we have already intimated, worthy of notice, and it is equally deserving of mention in such a journal as this that Prof. Lowe, distinguished for his ballooning exploits during the Civil War and for the gas system he invented and introduced, was the first to propose and assist in carrying out the combined operation of gas and electric lighting plants now so com-

mon but once so bitterly resisted. It need not surprise us that such a man, familiar with the enormous development of mountain travel and mountain hotels in the Swiss Alps

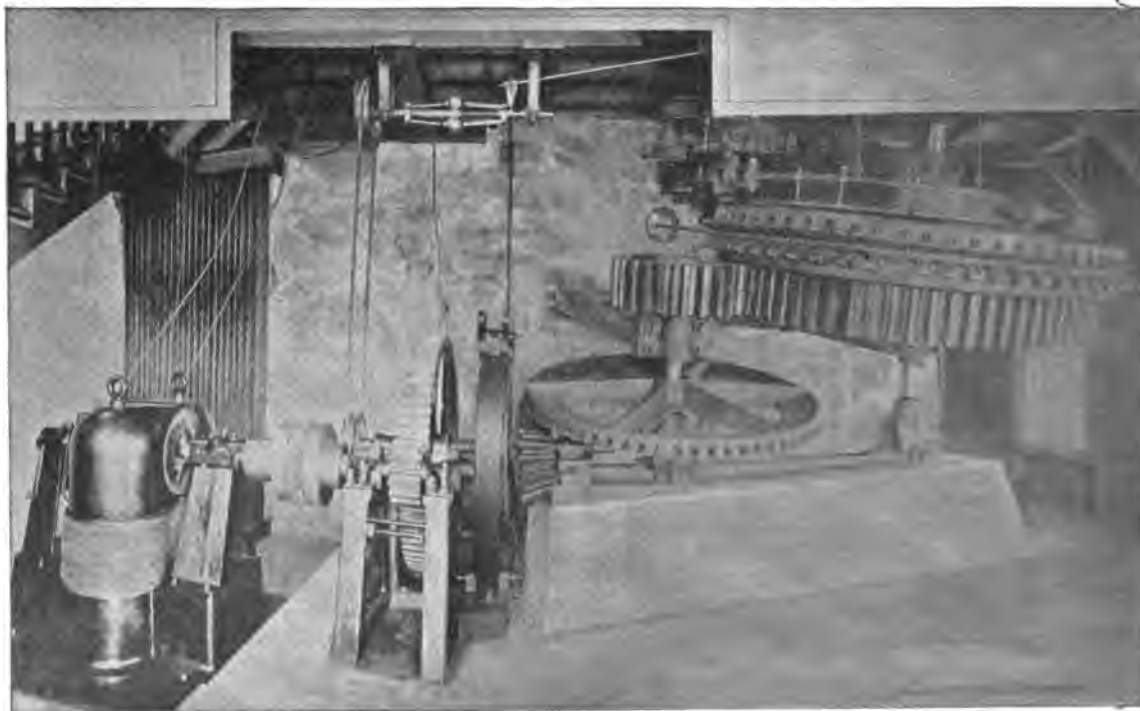


REGULATING APPARATUS FOR CABLE INCLINE, MT. LOWE RAILWAY.

should have spent a large fortune in developing successfully the same means of recreation for Americans in the Pasadena Alps of Southern California, where tropical resources of pleasure abound that are not available in the playground of Northern Europe.

high. Thence the trolley line runs by easy grades, nowhere exceeding $7\frac{1}{2}$ per cent, to the Rubio Pavilion nearly 3 miles away, at an altitude of about 2,200 feet. This trolley section is well built, with bracket suspension of the trolley wire, and the track construction is excellent, as it need be in view of the large amount of curve of short radius. There are no fewer than eleven solid timber bridges on the stretch from Altadena to Rubio. Part of the road here had to be cut through solid granite by men who dangled in mid-air from ropes while they drilled and blasted. The little power house at Altadena is novel and interesting. It comprises two Otto gas engines of 60 h. p. each, capable of working up to 140 h. p. together. These drive an Edison generator of corresponding capacity, and a duplicate plant is held in reserve. Gas for fuel is made from gasoline, the carburetter and storage tank being situated near by. It is proposed, however, to utilize water power for the work by means of Pelton wheels installed at Rubio Pavilion, at the foot of the Great Cable Incline, and the water pipes for this system are already laid and final arrangements nearly completed. Current is not only furnished from Altadena to the trolley road direct but is also delivered to a Keith motor of 75 h. p. which drives the mechanism of the cable road; so that we have the unique instance of electricity running a trolley road and a cable road at one and the same time from the same plant.

The trolley road ends at Hotel Rubio, which stands in Rubio Amphitheatre, a beautiful and romantic spot graced with no fewer than eleven waterfalls the power of some of which is already utilized in lighting the Great Cable Incline and the two hotels built for the accommodation of patrons of the road. Here starts the Great Cable Incline, about 3,000 feet long, rising about 1,300 feet, and unrolling in its ascent a magnificent panorama of mountain, valley and sub-tropic vegetation. This Incline is double track, the inner rail serving as one side of either of the tracks, and the cars passing each other on a four rail turn-out



ELECTRIC MOTOR AND CABLE OPERATING APPARATUS, MT. LOWE RAILWAY.

The ascent from the valleys is easy. Pasadena itself is about 800 feet above sea level, and Altadena Junction, where the Los Angeles Terminal Railroad delivers its passengers to the Mount Lowe trolley road, is about 1,000 feet

about half way up. There are two cars, which are permanently attached to an endless wire cable $1\frac{1}{2}$ inches in diameter. As one car descends the other goes up. The cars have rounded fronts, and have the

seats arranged in three tiers of open "opera box" compartments, so that everybody has a clear and uninterrupted view. The car makes a trip in eight minutes, and will carry nominally 36 passengers, although 60 New Yorkers, trained in bad habits on the Elevated Road, have been known to squeeze in at once. The Incline is most substantially built, being practically terraced in the mountain side. There is some open work, however, and at one point the cars cross a trestle 200 feet long, one end of which is 100 feet higher than the other. Two of our illustrations show the modus operandi of running the cable. It will have been noted that the cars are balanced against each other, so that the call for extra lifting power is not great. The motor operates the train of gearing and the cable wheel, a feature of which is its sensitive automatic arrangement (of the Hallidie clip pulley type) for gripping the cable upon any strain above the normal, which thus prevents the cars from traveling beyond a predetermined speed. This is a quite necessary point of precaution when we remember that the average grade of the road is 59 per cent. or 11 per cent. steeper than the steepest portion of the Mt. Pilatus road in Switzerland. The clip pulley is set horizontally, and the whole mechanism is firmly anchored



PROF. T. S. C. LOWE.

in solid granite. Upstairs, above the motor room, is the room in which the attendant operates the Incline, having all the control apparatus at his hand, and being in communication with the power house, etc., by means of the telephone.

At the summit of the Great Cable Incline we reach Echo Mountain House, 3,500 feet above sea level. This altitude with its lovely scenery would satisfy most people, but Prof. Lowe is pushing on to the summit of Mount Lowe, 6,000 feet high, and from the upper end of the Great Cable Incline proposes to run another trolley road connecting the Echo Mountain with an observatory, hotel, etc., at the summit of the noble peak named after him. Prof. Lowe has proposed that if a public or private subscription of \$100,000 be made, in the purchase of stocks or bonds of the road, he will himself furnish the rest, for the extension of the road, and will also equip the observatory with a 37½ inch reflector, a 16 inch refractor, a 12 inch refractor and two 8 inch refractors, making a splendid outfit for astronomical work at a point where the conditions are peculiarly favorable for star study. This subscription would not need to be a donation (as was the case with the Lick Observatory), but being in the secur-

ities of the road, is considered by all competent financiers, who are familiar with its working, as a first-class investment, while at the same time furthering a worthy scientific project for the benefit of the world. We are enabled to state to our readers that if any individual will purchase this amount of securities, one of the noble peaks of the Sierra Madre range will be named after him, thus carrying his name down through all ages—a memorial more lasting and far more honorable than marble column or ostentatious tomb. It must be the wish of all who, like the present writer, know Prof. Lowe, that he may be no less successful than was Mr. James Lick in enlisting public support for such a praiseworthy scheme. Electricians will also be interested to learn that Prof. Lowe intends setting up a fine search light at the peak of Echo Mountain and that he is already in correspondence with American and European makers on the subject.

Before closing this article it should be added that there are a great many features of novelty and interest about the road beyond those already spoken of. At Rubio Pavilion, for example, the electric cars have their terminus in the hotel attic, and it might be said with truth that the roof of the hotel was built first. The means of entrance are akin to those patronized by Santa Claus, and one descends by means of the chimney—or elevator. Another curious feature is that Echo Mountain House is on one side of the mountain and its kitchen on the other, the connection being a tunnel lighted by incandescent lamps. Prof. Lowe certainly deserves congratulation on this original scheme for getting the cuisine out of range. Electric lights are also used with novel and beautiful effect in Rubio Cañon and the Thalehaha Falls; and the proprietors of Eastern mountain resorts could in more than one respect take a leaf out of Prof. Lowe's book.

We are indebted to Prof. G. Wharton James, F.R.A.S. (an accomplished lecturer, associated with Prof. Lowe in this enterprise) for much of the information contained in this article and for a fine set of photographs of the road, hotels, mountains, etc., of this wonderland of the Sierra Madre range.

ELECTRIC RAILWAY FIGURES IN ST. LOUIS.

SOME interesting figures were given out regarding the operation of the electric and cable roads of St. Louis. The National Railway Co., a Chicago corporation, capitalized at \$2,200,000, controls five of the St. Louis roads, as follows: Cass Ave. and Fair Grounds (including the Northern Central and Union railways), electric, 35 miles and 70 motor cars; Citizens', 18 miles cable and 3 horse, and 173 cars in all; and the St. Louis R.R. Co.'s line operating 14½ miles of cable and having an equipment of 240 cars. At the annual meeting of this company held in Chicago it was announced that the net earnings for the year were \$199,947 or 9.088 per cent. against 10 per cent. earned in 1892. The gross receipts of the five roads were \$1,416,817, a decrease of 1.4 per cent. Operating expenses were 60.12 per cent. of gross receipts. The number of trips in 1893 was 877,803, a decrease of 16,988. The car mileage was 11,844,081, and the passengers carried 23,318,504—decreases, respectively, of 108,326 and 385,821. The gross receipts of cable lines were \$1,085,455 while the gross receipts of horse and electric lines amounted to \$381,872. Cable receipts decreased \$50,987 while horse and electric car receipts increased \$30,258. Comparing operating expenses it appears that the cable line expense was 59.4 per cent. of the income while horse and electric expense was 64 per cent. The cable mileage was 9,868,758 and of horse and electric lines 2,475,273. The cost of operating the cable per car mile was 7.32 cents or, including interest, 9.34 cents; while the corresponding figures for horse and electric lines were 11.09 and 18 11 cents. The new construction of the year which has cost \$1,201,356 included 32.37 miles of new track, 38.2 miles of overhead electric construction, 70 motor cars and remodeling 181 old trailers, engines, power plant, etc. D. G. Hamilton, of Chicago, is president of the company.

PROF. BARRETT AND THE CONDUIT.

PROF. JOHN P. BARRETT, city electrician of Chicago, has declared that, according to his judgment, the Love underground trolley system, as now running in Washington, affords "a complete solution of the question of trolley electric street railroads."