

ECRA-002
12/87NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS WASTE MANAGEMENT
INDUSTRIAL SITE EVALUATION ELEMENT
CN 028, TRENTON, N.J. 08625

ENVIRONMENTAL CLEANUP RESPONSIBILITY ACT (ECRA)

INITIAL NOTICE

SITE EVALUATION SUBMISSION (SES)

This is the second part of a two-part application form. This information must be submitted within 45 days following any applicable situation as specified at N.J.A.C. 7:26B-1.5 or any triggering event as specified at N.J.A.C. 7:26B-1.6. Please refer to the instructions and N.J.A.C. 7:26B-3.2 before filling out this form. Answer all questions. Should you encounter any problems in completing this form, we recommend that you discuss the matter with a representative from the Element. Submitting incorrect or insufficient data may cause processing delays and possible postponement of your transaction. Please call (609) 633-7141 between the hours of 8:30 a.m. and 4:30 p.m. to request assistance.

PLEASE PRINT OR TYPEDate August 3, 19891. Industrial EstablishmentName Battery Products Inc.Address 75 Belmont AvenueCity or Town Belleville and Bloomfield Zip Code 07003Municipality Belleville and Bloomfield County EssexA. Operational and Ownership History: (Attach additional sheets if necessary)

Name	Owner/ Operator	From	To	Current Address
McGraw Edison Co.	Owner and Operator	1940	1985	Suite 4000 1001 Fannin St. Houston, TX 77002
Cooper Industries, Inc.	Same	1985	present	Same

B. Brief description of past operation(s) conducted on site (Attach additional sheets if necessary)

Battery Products Inc. manufactured primary zinc-air batteries, both dry and wet, along with battery charging equipment. These processes are described in detail in Appendix 2 of the SES submitted August 20, 1989 for the previous ECRA Case No. 86528, which is included in the Attachment for the response to item 5 of this SES.

ECRA-002
12/87

2. List all federal and state environmental permits applied for, or received, or both, at this facility (*Attach additional sheets if necessary*)

Check here if no permits are involved _____

A. New Jersey Bureau of Air Pollution Control

Permit Number	Certificate Number	Date of Approval or Denial	Reason for Denial (if applicable)	Expiration Date
See attached list, Attachment 1				

B. New Jersey Pollutant Discharge Elimination System (NPDES)

Number	Discharge Activity	Date Issued or Denied	Expiration Date	Body of Water Discharged Into
None	No direct discharge			

- C. United States Environmental Protection Agency (EPA) Identification Number and copy of the most recent generator Annual Report prepared pursuant to the New Jersey Hazardous Waste Regulations. (*If applicable*)

ID # NJD060779949

Is a copy of the Annual Report attached? XX Yes (See Attachment #) No

- D. Resource, Conservation, Recovery Act (RCRA) Permit # None

- E. Bureau of Underground Storage Tank Registration Number(s) All USTs removed

- F. All other federal, state, local governmental permits.

Agency Issuing Permit	Permit No.	Date of Approval or Denial	Expiration Date
Passaic Valley Sewerage Commissioners	01404620	3/17/86	3/17/91

ECRA-002
12/87

3. Summary of Enforcement Actions for Violation of Environmental Laws or Regulations:

Check here if no enforcement actions are involved _____

A. Date of Action June 6, 1984

Section of Law or Statute violated NJSA 58: 10A-6a, NJSA 58: 10-23.11c

Type of Enforcement Action Directive Letter from NJDEP

Description of the Violation Alleged discharge of wastewater from surface unlined pretreatment lagoons.

How was the violation resolved? Ceased operation of lagoon.

B. Date of Action November 9, 1984

Section of Law or Statute violated NJSA 58: 10A-6a, NJSA 58: 10-23.11c

Type of Enforcement Action Directive Letter from NJDEP

Description of the Violation Alleged discharge of wastewater from surface unlined pretreatment lagoons.

How was the violation resolved? Submitted plan for hydrogeological investigation as per directive.

C. See Attachment 4.

D. See Attachment 4.

4. Site Map

Is this map enclosed: X Yes (See Attachment # 2) _____ No

If No, state the reason _____

(Attach additional pages, if necessary)

ECRA-002
12/87

5. Description of Operations:

Is this report enclosed? ☒ Yes (See Attachment # 3) ☐ No

If No, state the reason _____

6. Description of Building Heating System:

A. How is the Industrial Establishment currently heated? (Oil, Gas, Electric) Oil and Gas

How long has the Industrial Establishment been heated by the above fuel/energy source: 98 years

B. Was the Industrial Establishment heated by fuel oil at any time: ☒ Yes ☐ No

Is information on the decommissioning of underground fuel oil tanks included with item No. 14 of this form?

☐ Yes ☒ No If no, explain below: The fuel oil storage tanks for the
building heating system are above ground tanks, not underground tanks.

C. Are the results of the Integrity Evaluation for Existing Underground Fuel Oil Tanks enclosed?

☐ Yes (See Attachment # _____) ☒ No If no, state the reason See above - no
existing UST's.

7. Summary of Industrial Establishment Wastewater Discharges of Sanitary and/or Industrial Waste:

A. Discharge Period		Discharge Type	Treatment By
From	To		
1987	Present	Sanitary only	Public Treatment Works
1966	1987	Sanitary/Industrial	Public Treatment Works
1940	1966	Sanitary/Industrial	Septic System/Settling basins

B. If the Industrial Establishment discharges sanitary and/or industrial wastes to a publicly-owned treatment plant, provide the name/address of that facility.

Name Passaic Valley Sewerage Commissioners Telephone # (201) 344-1700

Street Address 600 Wilson Avenue

Municipality Newark State NJ Zip Code 07105

Date(s) of Discharge	Nature of Discharge
1. <u>1979-1987</u>	<u>Industrial, carbon and lime fines (high pH)</u>
2. <u>1966-1979</u>	<u>Same as above plus heavy metals</u>
3. <u>1966-present</u>	<u>Sanitary</u>

8. Hazardous Substance and Waste Containment Description: (Attach additional sheets if necessary)

Type of Storage Unit	Date Installed	Area or Volumetric Capacity (include units)	Material Stored	Construction Type	Location Reference	Decommissioning or Sampling Reference
None-all units	described in Appendix 3 of the 8/20/85 SES have been removed or closed.					

9. Hazardous Substance/Waste Inventory:

Material Name	Quantity (indicate units)	Location Reference	Storage Method Container Type/Size	Typical Annual Usage	To Remain on Site (Yes or No)
None-All materials described in Appendix 5 of the 8/20/85 SES have been removed off-site and sold for reclamation or properly disposed of as waste.					

ECRA-002
12/87

10. Discharge History of Hazardous Substances and Wastes:

- A. Have there been any discharges of hazardous substances and wastes?
☒ Yes (Complete Item B below) ☐ No (Go to Item 10C)

B. Summary of Discharges and Resolutions

<u>Description of Discharge Event</u>	<u>Response and Resolutions</u>
All known discharges and responses have been described in Appendix 6 of the 8/20/85 SES.	

- C. Is this Industrial Establishment subject to Spill Prevention Control and Countermeasure (SPCC) per 40 CFR Part 112 or Discharge Prevention, Containment and Countermeasure (DPOC) Plan per NJAC 7:1E-4.1 requirements?

☐ Yes ☒ No A copy of the Plan(s) may be required at the discretion of the Department.

11. Sampling Plan Proposal

- A. Is sampling proposed at the facility? ☐ Yes (See Attachment # _____) ☒ No

If sampling is not proposed, please explain below. (Attach additional sheets if necessary)

Several rounds of sampling have been conducted since 1984 as described in the response to Item 5. A cleanup plan ("Remedial Action Plan") dated February, 1989 was submitted for NJDEP review on March 1, 1989 for ECRA Case No. 86528.

- B. Is groundwater sampling proposed? ☐ Yes ☒ No (Other than the monitoring including in cleanup plan submitted 3/1/89).

Note: If groundwater sampling is proposed under the plan, you must complete ECRA Form 002A "Request for Hydrogeologic Assessment" and submit it with the application.

ECRA-002

12/87

12. Decontamination/Decommissioning Plan

A. Is the facility Decontamination/Decommissioning Plan enclosed?

____ Yes (See Attachment # ____) ☒ No (Already submitted in 3/1/89 cleanup plan.)

B. If no, specify why decontamination/decommissioning is not considered necessary.

13. Historical Data on environmental quality at the Industrial Establishment

A. Were sampling results obtained on Environmental Quality for the Industrial Establishment?

☒ Yes (See Attachment # 3) ____ No

B. If sampling results were obtained but are not part of this application, please explain below:

Note: Specific sampling results may be found in case file for ECRA Case No. 86528.

14. List any other information you are submitting or which has been formally requested by the Department:

Description	Attachment #
_____	_____
_____	_____
_____	_____

FEE CHECKLIST

Include below a breakdown of the total fee submitted with this application. (See N.J.A.C. 7:26B-1.10 for the appropriate fees.)

Item	Amount (\$)
1. Initial Notice Review	
i. Without Sampling Plan	\$2,000.00
ii. With Sampling Plan that includes only underground storage tank analysis without groundwater monitoring	_____
iii. With Sampling Plan other than ii. above or iv. below	_____
iv. With Sampling Plan that includes any groundwater monitoring	_____
2. Sampling Data Review	_____
3. Negative Declaration Review	_____
4. Cleanup Plan Review	_____
Oversight of Cleanup Plan Implementation	_____

TOTAL FEE ENCLOSED \$ _____

ARE FEES ENCLOSED? ____ YES

KCRA-002
12/87

CERTIFICATIONS:

- A. The following certification shall be signed by the highest ranking individual at the site with overall responsibility for that site or activity. Where there is no individual at the site with overall responsibility for that site or activity, this certification shall be signed by the individual having responsibility for the overall operation of the site or activity.

I certify under penalty of law that the information provided in this document is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of N.J.S.A. 13:1K-6 et seq., I am personally liable for the penalties set forth at N.J.S.A. 13:1K-8.

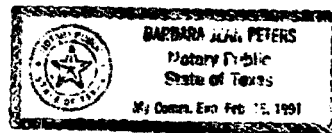
Typed/Printed Name R. W. Teets Title Director, Risk Management & Environmental Affairs
Signature *R. W. Teets* Date August 3, 1989

Sworn to and Subscribed Before Me

on this August 3 day of August 19 89

Barbara Jean Peters

Notary



- B. The following certification shall be signed as follows:

1. For a corporation, by a principal executive officer of at least the level of vice president;
2. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
3. For a municipality, State, Federal or other public agency, by either a principal executive officer or ranking elected official.

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate, or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of N.J.S.A. 13:1K-6 et seq., I am personally liable for the penalties set forth at N.J.S.A. 13:1K-8.

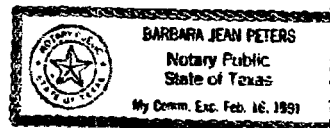
Typed/Printed Name C. J. Plesnicher Title Vice President, Employee Relations & Environmental Affairs
Signature *C. J. Plesnicher* Date 8-3-89

Sworn to and Subscribed Before Me

on this 3 day of August 19 89

Barbara Jean Peters

Notary



June 1989 SES - List of Attachments

Attachment 1 - Response to Item 2A - List of NDJEP Air Permits

Attachment 2 - Response to Item 4 - Site map

Attachment 3 - Response to Item 5 - Description of Operations

Attachment 4 - Response to Item 3C & D

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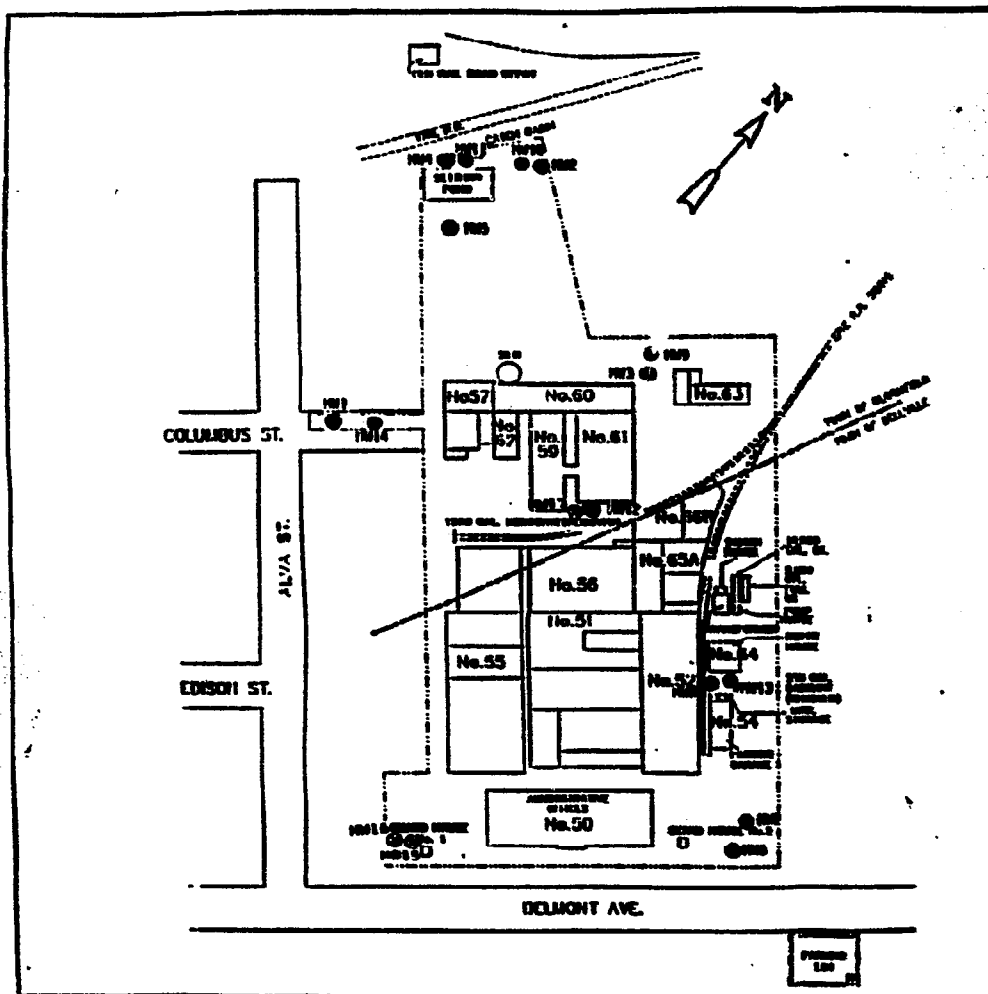
ATTACHMENT 1

<u>Permit No.</u>	<u>Date of Approval</u>	<u>Expiration Date</u>
065776	-----	08-01-88
046573	11-26-80	11-26-90
046494	08-13-80	10-20-89
046572	11-26-80	11-04-89
046356	08-13-80	10-20-89
045925	07-08-80	09-16-89
045897	07-07-80	07-07-90
045345	05-12-80	Cancelled 08-05-86
045344	05-12-80	Cancelled 08-05-86
043482	07-23-79	07-21-89
033861	10-28-77	04-19-88
022937	06-01-76	09-05-90
022773	09-09-76	09-09-91
037862	03-30-78	03-29-88
036426	12-29-77	09-15-88
036427	12-29-77	09-15-88
034172	08-15-77	03-30-88
022774	09-09-76	09-09-91
036431	09-15-78	09-15-88
036433	12-29-77	09-15-88
065775	---	08-19-88
036425	12-29-77	09-15-88
036428	12-29-77	09-15-88
036242	12-29-77	09-15-88
036240	12-29-77	Cancelled 08-05-86
046507	12-12-80	12-12-90
036430	12-29-77	09-15-88
036241	12-29-77	09-15-88
036239	01-03-78	09-15-88
030493	01-20-77	07-01-87
036238	12-29-77	09-15-88
036980	12-29-77	Cancelled 08-05-88

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ATTACHMENT 2
 RESPONSE TO ITEM 4 - SCALED SITE MAP

FIGURE 2-2



Legend:

- Fence & Property Line
- 50' Buffer from Erie Railroad
- Existing Monitoring Wells
- NEWLY INSTALLED
- Monitoring Well Location



WELL LOCATION MAP
 BATTERY PRODUCTS SITE
 BLOOMFIELD, NJ

Fred C. Hart Associates, Inc.

Reference: February 1989
 Remedial Action Plan
 ECRA Case No. 86528

Page 10

ATTACHMENT 3
RESPONSE TO ITEM 5
"DESCRIPTION OF OPERATIONS"
EXECUTIVE SUMMARY

The Battery Products site is located in the towns of Bloomfield and Belleville, New Jersey. The site is a battery manufacturing plant that was started by Thomas A. Edison in 1889. At present, the facility is not operational.

Numerous environmental assessments have been conducted at the Battery Products site since 1984. These investigations have resulted in the collection and analysis of over 200 hundred soil and groundwater samples. A summary of these investigations is presented below:

- 1984 - Sludge samples collected from the onsite settling pond by NJDEP were found to contain elevated concentrations of metal contaminants. Sludge material was excavated from the settling pond later that year.
- 1985 - IT Corporation installed monitoring wells and collected groundwater and soil samples. Elevated levels of total metals were detected in soils and unfiltered groundwater samples; low levels of volatile organic compounds were also detected in both media.
- 1985 - Fred C. Hart Associates conducted an extensive test boring program, collected groundwater and soil samples, and performed geophysical surveys to define source areas and assess the extent of groundwater and soil contamination.
- 1987 - Fred C. Hart Associates conducted an expanded remedial investigation under ECRA guidelines to further define source areas and the extent of contamination. Activities included installing additional monitoring wells, drilling test borings, and collecting groundwater and soil samples.

- 1988 - Soils Engineering Service, Inc. (SESI) conducted a geotechnical engineering investigation which included the completion of test borings and collection of samples for permeability analysis and chemical analysis. SESI also performed hydraulic testing (slug tests) on 8 on-site monitoring wells.

Data collected during these investigations has permitted the identification of source areas and the assessment of plume configurations. In addition, these investigations have resulted in the collection of over 200 samples which have been analyzed for a wide variety of chemicals. This data base is extensive and has allowed the site to be sufficiently characterized and evaluated to the extent that a remedial action plan can now be formulated.

The remedial action plan has been designed to stabilize and isolate areas of contamination and to prevent possible offsite migration. The remedial action plan recommends limited soils excavation, construction of a slurry wall and surface capping of soils.

Limited soils excavation will include the removal of mercury contaminated soils from the central portion of the site. It is suggested that this material be excavated because of the elevated mercury concentrations observed in this area. A treatment and disposal approach for these excavated soils will be evaluated based upon concentrations and total volume removed.

Installation of a slurry wall is proposed as part of the remedial plan to restrict groundwater movement across site boundaries. The slurry wall will be "keyed" into the silt/clay stratum located approximately 15 to 20 feet below grade. The slurry wall system will control groundwater flow onto and off of the site, thus minimizing the dissolution and migration of contaminants by groundwater. It will encompass the entire site, possibly including the offsite lagoon area (northwest of the site proper). Negotiations are currently taking place between Cooper Industries and PSE&G (the current owner of the lagoon area) to address the investigation and possible remediation of the offsite lagoons.

The entire site will be capped in order to prevent infiltration of surface water to the shallow upper water bearing zone. This procedure will eliminate dissolution and vertical migration of contaminants from the unsaturated zone to the water table. The surface cap will consist of either asphalt or concrete pavement placed over the soil and will also include aboveground drainage control structures to properly collect, channel and discharge storm water without contact to underlying soils.

The combination of the above proposed actions will effectively contain the chemicals present in soils and groundwater. Risks to human health and the environment will be eliminated by removing the potential for off-site migration, removing and stabilizing more highly contaminated soils near MW-17 and eliminating direct contact pathways with contaminated soils through the installation of a capping system.

***Reference:**

February 1989 Remedial Action Plan for ECRA Case No. 86528.

HART-RAP-02/89:slr

APPENDIX 2

CURRENT OPERATIONSI. Introduction

Batteries Products, Inc., Bloomfield, NJ, manufactures primary zinc-air batteries, both dry and wet, along with battery charging equipment. The manufacturing process is shown in diagrams following this narrative.

The manufacturing process generally consists of four (4) separate but simultaneous functions, with the end result of each function being assembled into a battery. The four functions are as follows:

- 1) Anode production
- 2) Cathode production
- 3) Electrolyte production
- 4) Lime refining

II. Anode Production

Highgrade zinc slabs are melted in the foundry area and combined with a master zincalloy containing 2% mercury. The melting process is controlled to obtain a final anode mixture containing 0.25% mercury. The molten material is cast with additional scrap material recycled into the melting pot. The casts are assembled into structures to be placed into the battery.

III. Cathode Production

Petroleum coke, graphite and acetylene black are combined with gilsonite and a hydrotreated naphthenic distillate to form a "green" mix. The material is then cured and milled before pressing into a block form.

(0233c-4)

Reference: 8/20/86
SES for ECRA Case No. 86528

These blocks are baked in furnaces where all materials are essentially transformed to coke. Volatiles are recaptured and burned in the plants boilers in a NJ permitted process.

The hardened coke blocks are machined and wetproofed by impregnating the blocks with kerosenes. Excess kerosene is driven off by heat and incinerated. A catalyst is deposited onto the block's surface by dipping into a solution of catalyst, ethanol and water. The alcohol and water are driven off by heating and also incinerated. The finished block is sent to the battery assembly area.

IV. Electrolyte Production

Electrolyte production is completed in two (2) methods, dependent upon the type of battery to be produced. These are the wet and dry methods.

Wet method - Zinc oxide, water and 45% potassium hydroxide liquid are combined in a mixing tank and placed in the battery casing.

Dry method - Potassium hydroxide flakes are melted and cast into shape. The cast is cooled and placed in the battery casing.

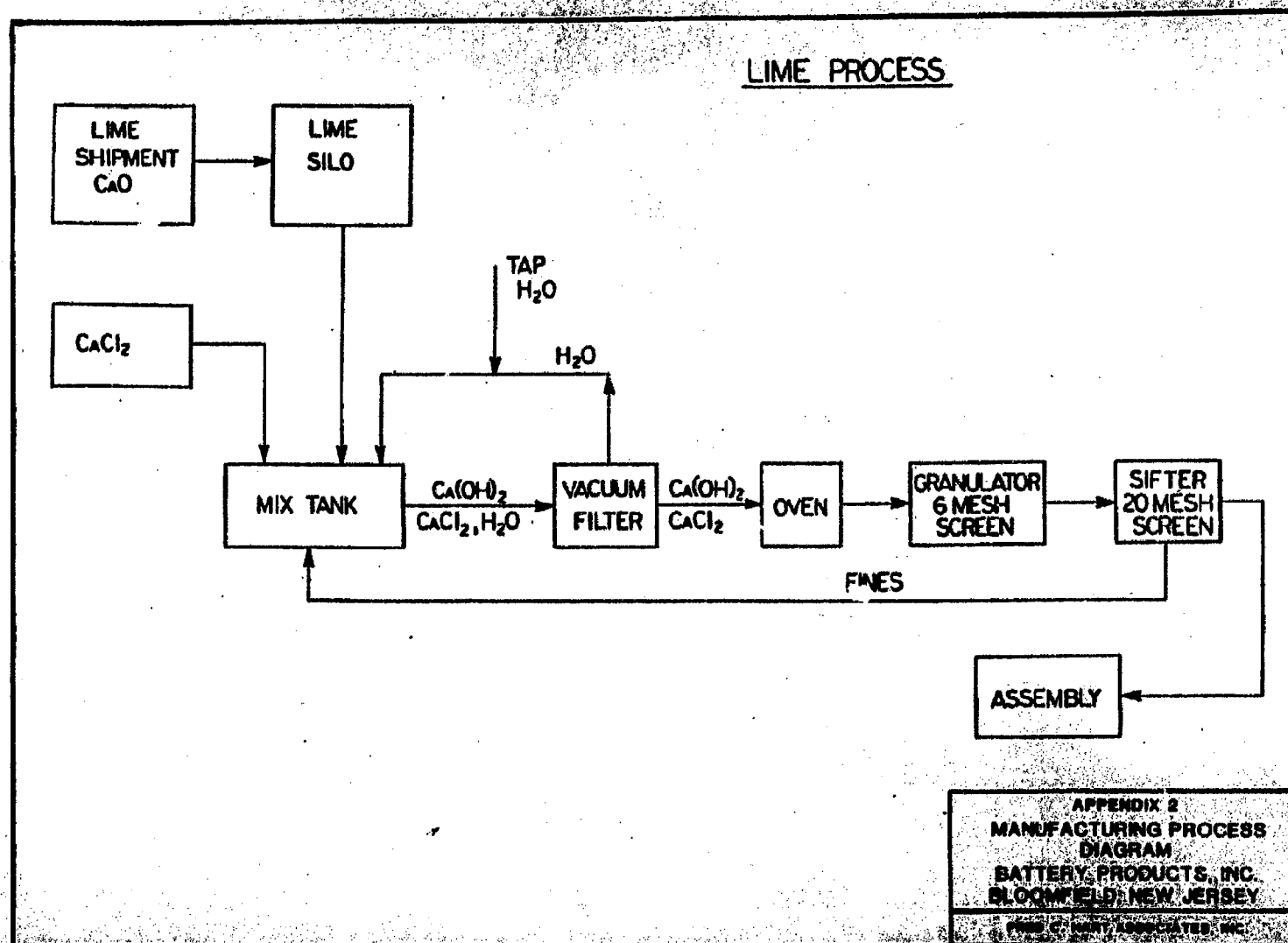
V. Lime Refining

Calcium oxide (quick lime) is combined with calcium chloride and water to produce calcium hydroxide (slaked lime). The calcium hydroxide is filtered, dried and granulated prior to being sent to the battery assembly area. Finally the materials are placed into the battery and sealed in place. Asphalt is used to seal the carbon block and either epoxy or a-methylene chloride based glue is used to seal the remaining battery components.

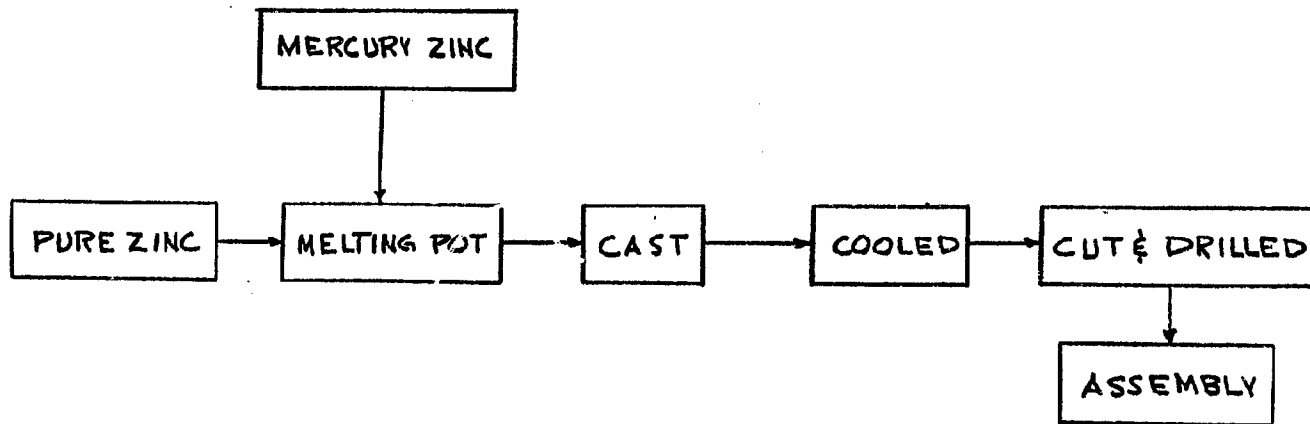
VI. Sewer System Map

A complete sewer system map detailing all floor drains, roof drains and storm sewers is found in Appendix 2.

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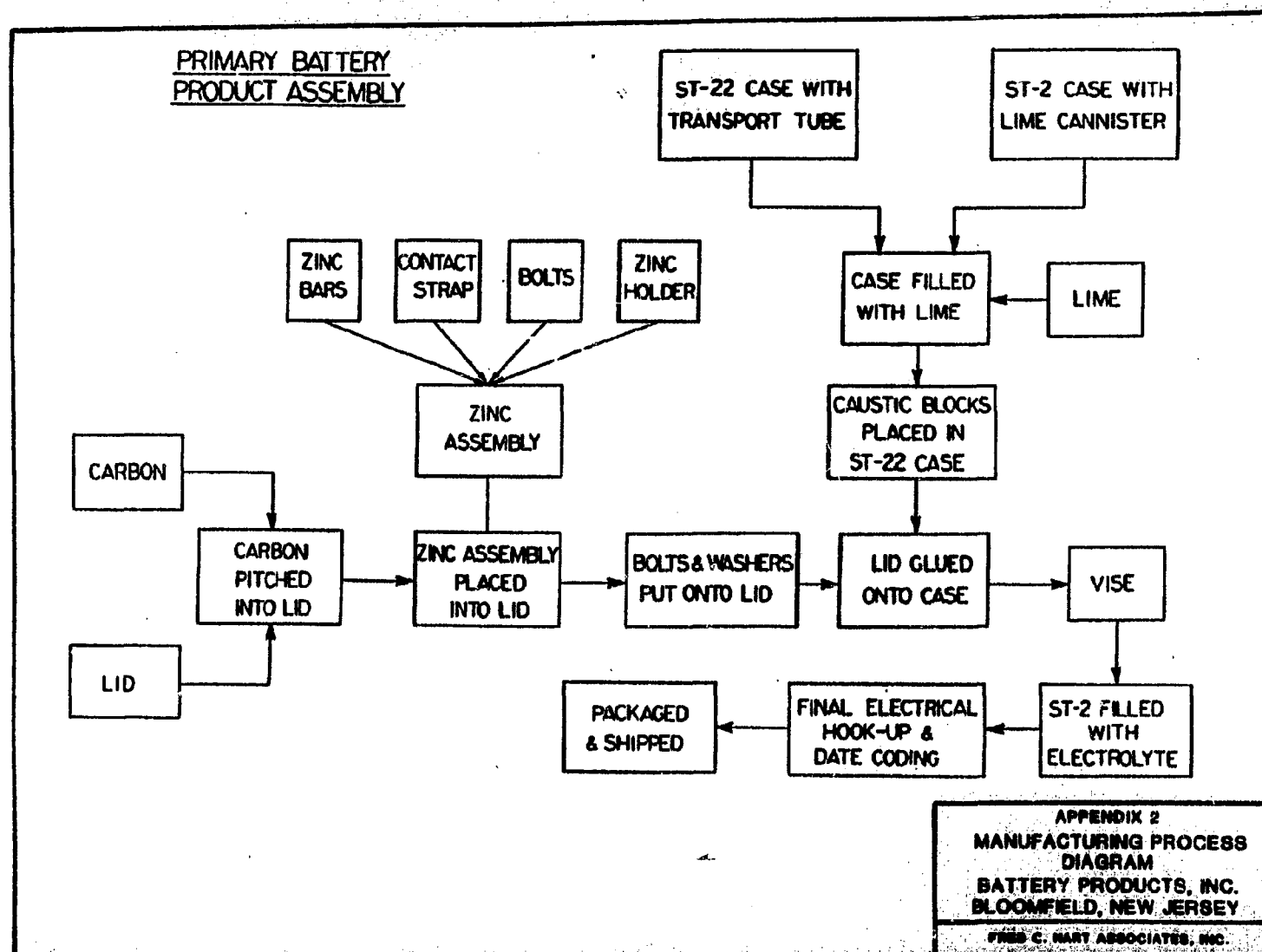


ZINC PROCESS



APPENDIX 2
MANUFACTURING PROCESS
DIAGRAM
BATTERY PRODUCTS, INC.
BLOOMFIELD, NEW JERSEY

FRED C. HART ASSOCIATES, INC.



ATTACHMENT 4

C. Date of Action: March 22, 1985

Section of Law or Statute Violated: NJSA 58: 10A-6a, NJSA 58: 10-23.11c

Type of Enforcement Action: Directive letter from DEP

Description of the Violation: Alleged discharge of wastewater from surface unlined pretreatment lagoons

How was the violation resolved? Revised work plan for hydrogeological study submitted as per directive

D. Date of action: July 18, 1985

Section of Law Statute violated: NJSA 58:10A-6a, NJSA 58: 10-23.11c

Description of the Violation: Alleged discharge of wastewater from surface unlined pretreatment lagoons

How was the violation resolved? Continued to prevent discharge or runoff from lagoons

JUNE.28/JB/ir

TO THE STOCKHOLDERS OF THE EDISON STORAGE BATTERY CO.

After the incorporation of the company in May, 1901, considerable experimental work was required in connection with the development of the battery, so that actual commercial manufacture was not started until January, 1903, at the plant in Glen Ridge, which had been purchased for the purpose. Subsequently the Glen Ridge plant was shut down and a new up-to-date and very much larger factory was constructed at Orange. Some difficulty was experienced in connection with the cells which were put out, due to the fact that leaks developed in the cans, but this was overcome by providing the cans with welded seams. Actual commercial experience developed the fact that the Type "E" cells made at the Glen Ridge plant showed a loss of capacity due to the swelling of the pockets in the positive plates, and because of this trouble the Glen Ridge plant was shut down on November 1, 1904, at which time we were turning out about 200 cells per week. Up to the time of that shut-down we had manufactured the equivalent of 37,068 "E-18" cells and the equivalent of 18,980 "E-18" cells replacements. A replacement cell is one in which we use everything ~~as~~ the old cell except the positive plate, the customers returning the old cells to us. From November, 1904, until October, 1908, experiments have been continuously made, and the difficulty of the swelling of the pockets in the positive plates is believed to have been overcome by the use of cylindrical tubes instead of flat pockets. By this change I have every reason to believe that the life of the new cell will be from two to three times that of the old type "E" cell, while the average life of the "E" type cell in commercial vehicles operated by firms having a large number of vehicles in use has been from two to three years, depending on the care

the batteries have received. The manufacture of the new battery is being actively prosecuted and the outlook for the business is good, since there is undoubtedly an enormous field for storage batteries outside of trucks and vehicles--fields that may be added where the lead battery has failed completely, such as car-lighting, marine lathes, submarine work, street cars and sparking batteries for gasoline engines.

At the present time we have over 260 commercial delivery wagons operated with Edison batteries of the old type and in every instance the user has obtained better results than could possibly have been secured from the lead cell. Some of the prominent users of the Edison batteries in New York City are the following:

Adams Express Co.	Geo. Ehret Brewery
United States Express Co.	New York Telephone Co.
Tiffany & Co.	Lewandos French Dyeing & Cleansing Co.
R. H. Macy & Co.	A. G. Hyde & Co.
W. & J. Sloane	New York Dock Co.
James A. Hearn & Son	Twentieth Century Auto Touring Co.
A. A. Vantine & Co.	Firestone Tire & Rubber Co.
Aitken Son & Co.	Lidgerwood Mfg. Co.

A considerable ^{number} of automobile manufacturers have signified their intention to adopt the Edison battery as soon as we are in position to furnish them, and among these prospective users are the following:

General Vehicle Co.	Detroit Electric Co.
Commercial Truck Co.	Rausch & Lang Carriage Co.
Studebaker Automobile Co.	Champion Wagon Co.
Baker Motor Vehicle Co.	Pittsburgh Motor Vehicle Co.

Waverly Automobile Co.

Oliver P. Fritchle, Denver, Col.

Couple Gear Freight Wheel Co. Woods Motor Vehicle Co., Chicago

S. R. Bailey & Co.

Anderson Carriage Co., Milwaukee

Columbus Buggy Co.

James McNaughton Co.

In conclusion I wish to impress upon the stockholders the fact that practically all the work that has so far been done has been experimental in character, but I believe the results which will be achieved will more than justify the expense and that the Edison battery will be a very great commercial success.

Respectfully submitted.

President.

05/14/2010 10:59 FAX

005/007

is to say: Two Hundred Dollars acknowledged received by signing this Agreement, Party of the first part agrees to take a second Mortgage for One Thousand Dollars and for one year with 6% interest and the balance from the purchase price party of the second part agrees to pay, on date of settlement. Party of the second part shall have the right to take Eight Thousand Dollars as a first Mortgage. Taxes, water, sewer, street, or any assessments or violations party of the first part agrees to pay till date of settlement. AND IT IS FURTHER AGREED, by the parties to these presents, that the said party of the second part, their heirs and assigns, may enter into and upon the said land and premises, on the day of settlement next ensuing the date hereof, and from thence take the rents, issues and profits to his and their use. And it is further agreed, by the parties hereto that the said deed-warranty shall be delivered and received at convenience to the party of the second part, between the hours of Ten in the forenoon and four o'clock in the afternoon on the said day of settlement next ensuing the date hereof. Party of the first part shall have the right to remain in his flat which he now occupies for one more year from date of settlement rent to be Twenty one Dollar per month. The entire hall inside shall be papered & woodwork painted and in the second floor rear kitchen bathroom & Bedrooms to be painted before settlement takes place. And for the performance of all and singular the covenants and agreements aforesaid, the said parties do bind themselves and their respective heirs, executors and administrators, and they hereby agree to pay, upon failure to perform the same, the sum of - which they hereby fix and settle as liquidated damages therefor.

IN WITNESS WHEREOF, the said parties have hereunto interchangeably set their hands and seals the day and year first above mentioned.

Signed, Sealed and Delivered
in the presence of
Norman Simon, Notary Public of N.J.

Barrie Dreskin	Seal
Selda Dreskin	Seal
Mary Brass	Seal
S. J. Viner	Seal

STATE OF NEW JERSEY SS:
COUNTY OF ESSEX

BE IT REMEMBERED, That on this Eleventh day of July, in the year of our Lord One Thousand Nine Hundred and Nineteen, before me, the subscriber, a Notary Public of New Jersey, personally appeared Barrie Dreskin & Selda Dreskin, who, I am satisfied, are the Grantors in the within Agreement named; and I, having first made known to them the contents thereof, they did then acknowledge that they signed, sealed and delivered the same as their voluntary act and deed, for the uses and purposes therein expressed. And the said Selda Dreskin being by me privately examined, separate apart from her husband, did further acknowledge that she signed, sealed and delivered the same as her voluntary act and deed, freely, without any fear, threats or compulsion of her said husband.

Norman Simon, Notary Public of N.J.

Received in the office July 16, A. D. 1919 at 3:35 P.M.

EDISON STORAGE BATTERY CO.
TO
GLEN RIDGE REALTY CO.

THIS DEED, Made the 2nd day of June, in the year of our Lord One Thousand Nine Hundred and Nineteen between Edison Storage Battery Company, a Corporation duly organized under

the laws of the state of New Jersey, of the First Part; and Glen Ridge Realty Company, a corporation organized under the laws of the State of New Jersey, and located in the Borough of Glen Ridge, County of Essex and State of New Jersey, of the Second Part: WITNESSETH, That the said party of the First Part, for and in consideration of One Dollar, lawful money of the United States of America, and of other good and valuable considerations, to it in hand paid by the said party of the Second Part, at or before the sealing and delivery of these presents, the receipt whereof is hereby acknowledged, and the said Party of the First Part, therewith fully satisfied, contented and paid, has granted, bargained and sold, and by these presents does grant, bargain, sell and convey to the said Party of the Second Part, and to its successors and assigns forever, All that certain tract or parcel of land and premises, hereinafter particularly described, situate, lying and being in the Borough of Glen Ridge, in the County of Essex and State of New Jersey.

DB V61 PG 235

RECORDED 7-16-1919.

006/007

05/14/2010 10:59 FAX

BEGINNING in the north-easterly line of Bloomfield Avenue at the easterly corner of property now or formerly of Mrs. M. Benson, which corner is also distant in said line of Bloomfield Avenue, three hundred and ninety-one and sixty-four one-hundredths feet more or less westerly from the center line of Herman Street; thence running along Bloomfield Avenue south twenty-three degrees, thirty-two minutes east, one hundred and sixty-nine and sixty hundredths feet; thence north forty-five degrees, twenty-seven and half minutes east, five hundred and forty and thirty-five one hundredths feet more or less to the southerly line of Belleville Avenue; thence along the same the different course thereof one hundred and thirty-seven feet or more, the north-easterly corner of said land; thence along the same south forty-eight degrees five minutes west, four hundred and seventy-two feet more or less to Bloomfield Avenue and place of BEGINNING. Being the tract or parcel of land and premises conveyed by Thomas A. Edison and Mina E. Edison, wife, to Edison Storage Battery Company by deed dated July 11, 1901 and recorded in the Register's Office of the County of Essex, New Jersey, in Book N 34 of Deeds for said County, on pages 460 - 461.

TOGETHER with all and singular, the tenements, hereditaments and appurtenances to the same belonging or in anywise appertaining: Also, all the estate, right, title, interest, property, claim and demand whatsoever, of the said Party of the First Part, in and to the same, and every part and parcel thereof; TO HAVE AND TO HOLD, all and singular the above described land and premises, with the appurtenances, unto the said Party of the Second Part, its successors and assigns, to the only proper use, benefit and behoof of the said Party of the Second Part, its successors and assigns forever: And the said Party of the First Part does for itself and its successors, covenant to and with the Party of the Second Part, its successors and assigns that the said Party of the First Part is the true, lawful and right owner of all and singular the above described land and premises, and of every part and parcel thereof, with the appurtenances thereto belonging; that the said land and premises, or any part thereof, at the time of the sealing and every of these presents, is not encumbered by any encumbrances whatsoever, by which the title of the said Party of the Second Part, hereby made or intended to be made for the above described land and premises, can or may be changed, charged, altered or defeated in any manner, or to any extent whatsoever; And Also, that the said Party of the First Part, now has good right, full power and lawful authority, to grant, bargain, sell and convey the said land and premises in manner aforesaid. And Also, that the said Party of the First Part will warrant, and forever defend the said land and premises unto the said Party of the Second Part, its successors and assigns, forever, against the lawful claim and demands of all and every person or persons, free, clear, and discharged of and from all manner of encumbrances whatsoever.

IN WITNESS WHEREOF, the said Party of the First Part has caused these presents to be signed by its Vice President and its common seal to be hereto affixed, the day and year first above written.

Signed, Sealed and Delivered

in the presence of

Attest: Arthur Mudd,
Secretary

EDISON
STORAGE
BATTERY COMPANY
INCORPORATED
1901.

Edison Storage Battery Company
By Stephen B. Lambert,
Vice President

STATE OF NEW JERSEY SS:
COUNTY OF ESSEX

BE IT REMEMBERED, That on this 2nd day of June, in the year of Our Lord One Thousand Nine Hundred and Nineteen before me, the subscriber, a Notary Public in and for the State of New Jersey, personally appeared Arthur Mudd, who being by me duly sworn, doth depose and make proof to my satisfaction, that he well knows the corporate seal of Edison Storage Battery Company the grantor named in the foregoing deed; that the seal thereto affixed is the proper corporate seal of said corporation; that the same was so affixed thereto, and the said deed signed and delivered by Stephen B. Lambert, who was at the date and execution thereof, Vice President of said corporation, in the presence of the said deponent, as a voluntary act and deed, of the said corporation, and that the said deponent signed the same as subscribing witness, sworn and subscribed before me on the date aforesaid.

Arthur Mudd

Wesley A. Bremer, (N.J.)

Notary Public, State of New Jersey.

Commission expires June 2, 1921.

Received in the office July 10, A. D. 1919 at 3:36 P.M.

05/14/2010 11:00 FAX

007/007

and deed, for the uses and purposes therein expressed. And the said Lillie Streesberg and Tillie Kurland, wives as aforesaid being by me privately examined, separate and apart from their said husbands, further acknowledged that they signed, sealed and delivered the same as their voluntary act and deed, WITELLY, without any fear, threats or compulsion of their said husbands.

Harry J. Beiwirth, A Master in Chancery of New Jersey.
Received in the Office, May 6th, A.D. 1924 at 2:07 P.M.

No. 61

RED
10
GLEN RIDGE REALTY COMPANY
TO
THE BOROUGH OF GLEN RIDGE

V70-23-25/6/24
THIS INSTRUMENT, made the twenty-ninth day of February in the year of Our Lord One Thousand Nine Hundred and Twenty-four BETWEEN Glen Ridge Realty Company, a corporation of

the Borough of Glen Ridge in the County of Essex and State of New Jersey of the First Part; AND The Borough of Glen Ridge, in the County of Essex and State of New Jersey, a municipal corporation, WITNESSETH, That the said party of the first part, in consideration of the sum of Twenty-five Thousand Dollars lawful money of the United States of America, to it in hand paid, by the said party of the second part, at or before the enrolling and delivery of these presents, the receipt whereof is hereby acknowledged, has granted, bargained, sold, aliened, remised, released, conveyed and confirmed, and by these presents does grant, bargain, sell, alien, remise, release, convey and confirm, unto the said party of the second part, and to its successors and assigns forever, ALL that certain tract or parcel of land and premises, hereinafter particularly described, situate, lying and being in the Borough of Glen Ridge in the County of Essex and State of New Jersey:

BEGINNING in the northeasterly line of Bloomfield Avenue at the easterly corner of property now or formerly of Mrs. M. Benson, which corner is also distant in said line of Bloomfield Avenue three hundred and ninety-one and sixty-four one-hundredths feet, more or less, westerly from the center line of Main Street; thence running along Bloomfield Avenue south twenty-three degrees thirty-two minutes east one hundred and sixty-nine and sixty hundredths feet; thence north forty-five degrees twenty-seven and one-half minutes east five hundred and forty and thirty-five one-hundredths feet, more or less, to the southerly line of Belleville Avenue; thence along the same the different courses thereof one hundred and thirty-seven feet or more to the northeasterly corner of said Benson's land; thence along the same south forty-eight degrees five minutes west four hundred and seventy-two feet, more or less, to Bloomfield Avenue and place of beginning, BEING the same premises conveyed to the party of the first part by Edison Storage Battery Company, by deed dated June 2, 1919, and recorded in Book V 61 of Deeds for Essex County at page 230. THIS conveyance is made subject to the restriction that any building erected on the above described premises for business purposes shall be set back as far from the line of Bloomfield Avenue as the present Glen Ridge Stores Building. THIS conveyance is made especially subject to all assessments.

TOGETHER with all and singular, the tenements, hereditaments and appurtenances thereunto belonging, or in anywise appertaining, and the reversion and reversions, remainder and remainders, rents, issues and profits thereof, AND ALSO, all the estate, right, title, interest, property, possession, claim and demand whatsoever, as well in law as in equity, of the said party of the first part, of, in, or to the above described premises and every part and parcel thereof, with the appurtenances, TO HAVE AND TO HOLD all and singular the above mentioned and described premises, together with the appurtenances, unto the said party of the second part, its successors and assigns forever, to the only proper use, benefit and behoof of the said party of the second part, its successors and assigns forever. AND the said party of the first part does for itself, its successors, assigns and administrators covenant and grant to and with the said party of the second part, its successors and assigns, that it the said party of the first part, is the true, lawful and right owner of all and singular the above described land and premises, and of every part and parcel thereof, with the appurtenances thereunto belonging; and that the said land and premises, or any part thereof, at the time of the sealing and delivery of these presents, are not encumbered by any mortgage, judgment, or limitation, or by any encumbrance whatsoever, by which the title of the said party of the second part, hereby made or intended to be made, for the above described land and premises, can or may be changed, charged, altered, or defeated in any way whatsoever except as aforesaid. AND ALSO, that the said party of the first part now has good right, full power and lawful authority, to grant, bargain, sell and convey the said land and premises in manner aforesaid; AND ALSO, that the said Glen Ridge Realty Company will WARRANT, secure, and forever defend the said land and premises unto the said Borough of Glen Ridge, its successors and assigns, forever, against the lawful claims and demands of all and every person or persons, freely and clearly freed and discharged of and from all manner of encumbrance whatsoever, except as aforesaid.

IN WITNESS WHEREOF, the said party of the first part has caused its common seal to be hereto affixed and attested by its Secretary and these presents to be signed by its President, the day and year first above written.

Attest:
Wendell M. Strong
Secretary



Glen Ridge Realty Company
By Henry G. Cordley
President

RECORDED 5-6-1924

DB V70 PG 31

05/18/2010 15:43 FAX

001/010



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MAY 18, 2010

STEPHEN PALLEY, ESQUIRE
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WASHINGTON, DC 20004-2402

RE: S-28211.03
EDISON STORAGE BATTERY CO.

DEAR STEPHEN:

PURSUANT TO YOUR SPECIFIC INSTRUCTIONS, WE HAVE COMPLETED THE CHAIN OF TITLE RESEARCH ON THE FORMER EDISON STORAGE BATTERY COMPANY PROPERTY IN THE BOROUGH OF GLEN RIDGE (NOW KNOWN AS A PORTION OF LOT 12 IN BLOCK 76) BETWEEN THE YEARS OF 1901 AND 1956, WHICH DISCLOSES THE FOLLOWING INFORMATION OF RECORD:

- (A) DEED FROM GLEN RIDGE REALTY COMPANY, A NEW JERSEY CORPORATION TO THE BOROUGH OF GLEN RIDGE, A MUNICIPAL CORPORATION, DATED FEBRUARY 29, 1924 AND RECORDED MAY 6, 1924 IN DEED BOOK V70 PAGE 31. (COPY ATTACHED)
- (B) DEED FROM EDISON STORAGE BATTERY COMPANY, A NEW JERSEY CORPORATION TO GLEN RIDGE REALTY COMPANY, A NEW JERSEY CORPORATION, DATED JUNE 2, 1919 AND RECORDED JULY 16, 1919 IN DEED BOOK V61 PAGE 235. (COPY ATTACHED)
- (C) DEED FROM THOMAS A. EDISON AND MINA M. EDISON, HIS WIFE TO EDISON STORAGE BATTERY COMPANY, A NEW JERSEY CORPORATION, DATED JULY 11, 1901 AND RECORDED JULY 18, 1901 IN DEED BOOK N34 PAGE 460. (COPY ATTACHED)
- (D) DEED FROM SARAH L. HAYDEN, EXECUTRIX AND CHARLES H. HAYDEN, WILLIAM B. HAYDEN AND ALBERT HAYDEN, EXECUTORS OF THE ESTATE OF PETER HAYDEN, DECEASED, TO THOMAS A. EDISON, DATED MAY 28, 1901 AND RECORDED JUNE 20, 1901 IN DEED BOOK L34 PAGE 237. (COPY ATTACHED)

ADDITIONALLY, I AM ENCLOSING COPIES OF THE OLD AND CURRENT TAX MAP OF THE BOROUGH OF GLEN RIDGE FOR YOUR PERUSAL, ALONG WITH OUR REVISED INVOICE.

LASTLY, IF YOU WISH FOR US TO EXPAND OUR RESEARCH BEYOND 1956, PLEASE ADVISE ACCORDINGLY.

VERY TRULY YOURS,

SHAWN SIMONS
FOR THE COMPANY

SS/LV
ENC.



(<https://www.glenridgehistory.org>)

HOME ([HTTPS://WWW.GLENRIDGEHISTORY.ORG](https://www.glenridgehistory.org))

GLEN RIDGE HERITAGE BOOK 1977

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RIDGE-HERITAGE-BOOK-1977/](https://www.glenridgehistory.org/category/glen-ridge-heritage-book-1977/))

The Mills

([https://www.glenridgehistory.org
mills/](https://www.glenridgehistory.org/mills/))

The highly residential community of Glen Ridge was originally an industrial town marked by a row of mills strung along the valley of Toney's Brook, an important source of water power. Early in the 1800's Toney's Brook was strong enough to deliver some 50-75 horsepower.



Some of the most noted men in the history of this area, men whose family names run throughout Glen Ridge's heritage, were owners of the five mills that were near the now insignificant stream called Toney's Brook.

THE BROMLEY MILL Named Bromley Mill because of its early ownership by English millwright Dury Bromley and his partner Thomas Oakes, the sawmill was originally built by Abijah Dodd. Dodd and his wife Mary lived in a house just west of the present site of the entrance to the Grand Union parking lot on Bloomfield Avenue, and he built the mill and dam approximately where Matchless Metal Company stands today.

On February 1, 1806, Dodd sold his saw-mill, dam and pond, together with about three acres, to Bromley and Oakes. He gave them the right-of-way past his house to get to their mill from the "Main Road."

By 1810 the "Main Road" was the Newark-Pompton Turnpike and the two millwrights bought another two acres from Dodd and his wife fronting on the turnpike. Bromley built his house roughly where the Grand Union stands and Oakes across the turnpike just southeast of Christ Church.

Oakes died quite young, in 1823, while working as chief engineer of the Schuylkill Canal in New York, but Bromley continued to work the mill. In the 1830's he converted it to a fulling mill for woolen cloth and added a dyeing

house where he did printing on silk and calico.

Both Bromley and Oakes were known for building and repairing all types of mills and were in great demand for this. In 1823 the Watering Committee of the town of Fair Mount, (now part of Philadelphia) wrote to Dury Bromley that his "services are very highly appreciated by the Committee for the faithful execution of the work entrusted to his care and which they believe can vie with any in the United States if not any in the world."

As with homesteaders of that time, Bromley sold the produce from his land that he couldn't use himself, like hay and split fence wood. He kept a careful accounting of all his affairs in a day book. The entry for May 27, 1846 reads, "Stormy day nothing doing. Paid Mary Sisco for 5 weeks washing in home \$1.25. Went to Newark took sick and came home in state and left the horse and wagon in Newark."

He had an attractive, clear handwriting and kept up an active correspondence with family and friends. Many of these letters survive and serve as commentary on customs and current events.

Bromley was born February 28, 1775 in Cranbrook, Kent, England and came to the United States in 1797. It seems that he left behind a sorrowing sweetheart, for his cousin William wrote from Cranbrook in 1799: "Saley Sims take it hard that you Left har in Such a Slay Maner and She has ben at my hous three or four times and Cries to think that you have Left harr and She says that She would Come to you if you would Send for harr at anney time for nothing Should Stop harr but Death."

Apparently unmoved by these entreaties, Bromley married the girl who lived near his new Bloomfield mill, Maria Cadmus. Four of their seven children lived to adulthood (Matthew, William, Jane and Amelia).

Dury and Maria Cadmus Bromley prospered. They bought two other properties in Bloomfield and one on the mountain in West Bloomfield (now Montclair). The mill, their house and adjoining property they deeded to their son William in 1847, the year before the elder Bromley died.

William Bromley was a ship's engineer, and by the age of 21 was superintendent of the Fulton Iron Works in Brooklyn. His job obviously did not leave him much time for his property in Bloomfield, and since his widowed mother needed money to support herself, in 1850 he sold the mill and surrounding four acres to James McCracken for \$3,912. Bromley retained his father's original home, however.

McCracken seems only to have made use of the dyeing house, for the 1859 map speaks of a "Chemical Works" being on the site. By 1863, however, McCracken's business must have failed, and his property passed into the hands of the Newark Savings Bank. In that same year John Hughes and Henry Roberts bought it from the bank for \$6,158. The deed describes the mill at that time as "in ruins."

Three years later Henry Woodbridge and his wife Mary paid Hughes and Roberts \$7,000 for the four acres, the dyeing house and the ruined mill. It is supposed that they put the mill back in working order but gave up making dye stuffs, because they got such a high price from the Reverend J.S. Gallagher (\$5,000) for that one acre plus land along what is now Hillside Avenue. The mill was known as "The Woodbridge Mill" for many years. The Woodbridges stayed in business there until 1897, although it is not known what they manufactured.

William Bromley died in 1890. Rosetta Bromley, his widow, died in the house in 1905, leaving it to her sisters, who seem not to have maintained it well. By 1910 an article in the Bloomfield paper described it as abandoned, with the wind blowing through.

Rosetta Bromley had sold part of her inheritance along what later became Clark Street, in 1891, for \$500. The buyer, James H. G. Mills immediately resold the same year to Asabel Darwin, who built the row of houses that stands there now. The remainder, the Borough of Glen Ridge bought in 1938 and made the small park and the parking lot which is leased by the Telephone Company.

The mill itself and its Bloomfield Avenue frontage were sold by the Woodbridges in 1897 to Power Manufacturing Company for \$4,750. The mill was destroyed that year and it is assumed that the red-brick building housing Matchless Metal factory on that site today was begun then. Power reputedly manufactured bicycle chains.

The factory then changed hands quickly several times: one owner was a Glen Ridge man, Wallace Schouler, who made the then new product called asphalt in it. Many miles of sidewalks and driveways in this area were laid down by Schouler.

In 1922 Matchless Metal moved in and has been making industrial buffing compounds there to the present time. In 1921, the Westlake family's bank sold the abandoned Bromley house and surrounding one acre to Silvestro Casabona. He was unable to restore it and sold to Guy Gabrielson of Bernardsville in 1925. Since the Borough of Glen Ridge refused to permit commercial development there, Gabrielson fought a 12-year battle to have it re-zoned. In 1937 he finally appealed to the State Supreme Court and was granted a variance. He built a gas station at the Glen Ridge end of the property.

Within two years Glen Ridge's Zoning Board of Adjustment took "a more decided step toward modernism than it ever did since the incorporation of the Borough" (Montclair-Glen Ridge Bulletin) and gave Gabrielson permission to build a Howard Johnson's restaurant. The restaurant was not successful and Gabrielson sold the building and land to Borough resident Frank Dailey. He converted it into a restaurant-bar called the "Glenbrook," but that venture, too, was unsuccessful. Anthony Cestone bought the "Glenbrook" in 1947 and kept it going for a while, but in 1954 he tore it down as well as the gas station and built the stores and parking lot now occupied by the Grand Union and Rite-Aid Drugs.

THE BROWER MILL The mill, which was known as Brower's Pasteboard or, more rarely, Paper Mill was built in the early 1820's by a group headed by Israel "King" Crane, one of the earliest industrialists in this area. He was, along with John Dodd, the moving force behind the construction of the Newark and Pompton Turnpike (now Bloomfield Avenue) and was instrumental in realizing the industrial potential of Toney's Brook.

Although now an insignificant stream, at that time, Toney's Brook was considered capable of delivering 50-75 horsepower and of supporting several mills. About 1812, the West Bloomfield Manufacturing Company was organized by Israel Crane and others. Two large building were erected near the present boundary of Glen Ridge and Montclair to manufacture cotton and woolen goods. The business was later sold.

In 1819, a group consisting of Israel Crane, Michael Cockefair and Christian Rolefson bought, for \$600, 3.11 acres of land on either side of Toney's Brook from Stephen Fordham Crane, Israel Crane's first cousin. The property was located in the lower Glen opposite what is now the Middle School. A mill, with a mill pond and raceways, was constructed, with the mill pond extending up the Glen past Ridgewood Avenue. It is not known if Israel Crane actually operated the mill, but the same property was sold to Charles Ward in 1825 for \$3,000. Crane gave Ward a three year mortgage for the full amount, but Ward evidently ran into difficulties, for no payments were made and the mortgage was foreclosed in 1826. The property was purchased at a sheriff's sale in 1827 by Samuel Brower of New York City, who paid \$150 in cash and assumed the mortgage of \$3,000.

Samuel Brower operated the mill until his death in 1830 when, at age 46, he died without leaving a will. In 1833 a sheriff's sale was held to satisfy his heirs, and George W. Brower, his eldest son, paid \$4,000 for the mill property and the Brower homestead. It stood on 7.34 acres on the site of the present Middle School. In 1836, both properties were deeded to his mother, Charlotte Vanderpool, who had married James Vanderpool, a wealthy Newark landowner.

She operated the mill with the aid of his husband until his death in 1842. In 1846, the property was deeded to her children, Samuel A. Brower and Mary Ann Brower Mather. The younger Brower was 28 at that time and operated the mill until the family lost control in 1880 after 34 years. Things apparently went along smoothly until 1856, when all the Brower lands, which included the mill, the homestead, and other property in Bloomfield, Belleville, and Orange, were mortgaged. The mill property was mortgaged to Amzi Dodd for \$4,500. It was paid-off in 1859, and the property was immediately remortgaged to the Newark Saving Institution. This mortgage was foreclosed in 1861. Erastus Colton, who had married Mary Ann Brower Mather, bought the mill property for \$2,500, and at the same sale, one of the Brower homes was sold to Joseph A. Davis, Jr., for \$4,100. In 1864, the mill property was deeded back to Louisa J. Brower, wife of Samuel A. Brower, for \$2,100.

The last sheriff's sale was held in 1880, when a mortgage given to the Washington Life Insurance Company of New York, in 1872 for \$5,500 was foreclosed. The property was purchased by the Washington Life Insurance Company for \$3,000. The property passed out of the control of the Brower

family. The property was sold to Thomas C. Dodd in 1884 for \$2,500. The mill and attached factory building were completely consumed by fire in 1889 with only the water wheel left standing. The property was purchased by the Glen Ridge Park Association in 1899 for \$7,000. This organization had been organized by public spirited citizens of Glen Ridge to prevent the Glen from undergoing private development. In 1901, the property was deeded to the Borough of Glen Ridge, together with two other tracts, for \$17,500.

The mill was usually known as a "pasteboard mill." There were two types of paper products which were called pasteboard. One was made by applying glue or paste between sheets of paper and then compressing in a press. Normally, only the finer types of board, such as playing cards and book boards were made in this manner. The other type was made by shredding used rag paper in a mill to a homogeneous suspension. The pulp was then transferred to a mold and formed into sheets. The wet sheets were placed in a press and squeezed almost dry. The sheets were then air dried. This second type was probably made in the Brower Mill, since power was required for the pulping of the used rag paper, and it is mentioned in one of the deeds that a band box manufactory was connected to the mill. A band box is a round box used to store collars, hats, etc., to prevent them from being crushed. A fairly stiff pasteboard would be required for this. Other pasteboard products were probably made also.

The business was never very prosperous and did not increase in size during its life. At a time when businesses were growing larger and larger, no new machinery was installed. Water power was used until the very end, even though the water available from Toney's Brook became less every year due to diversion of its headwaters. The mill would have required about eight to ten operators with perhaps twice as many in the attached manufactory.

The mill was a 2 ½ story building of about 21 feet by 36 feet. The manufactory, which was on the turnpike, had dimensions of about 116 feet by 23 feet. The wide part was on the turnpike. The main part of the building was four stories, with a central part of five stories, and the other part of two stories. Dana Mitchell remembers that it had a covered walk or piazza along its entire length on the turnpike.

Brower went to Castle Garden at the Battery in New York City, then the landing point for immigrants, to recruit workers for his factory.

The mill was evidently not operated after title passed to the Washington Life Insurance Company, although the factory was rented by a man who manufactured leather belts used to power machines. On May 5, 1889, a very serious fire occurred on the site. The assistant fire chief of Bloomfield, William B. Corby, who lived across from the present Hurrell Field, was seriously injured in the fire but recovered from his wounds. At the time of the fire, the factory was empty except for the carpenter shop of another man.

THE MOFFETT MILL Moffett's Brass Rolling Mill, or more properly The Bloomfield Rolling Mills, was located about one hundred feet east of the present Freeman Parkway Bridge on the north side of Toney's Brook. The mill

pond extended up the brook, beyond the bridge and then under the railroad, which ran over it on a wooden trestle.

The mill had its beginning on June 7, 1800, when Nehemiah S. Baldwin purchased a half-acre of land on the north side of Toney's Brook for \$112.50 from Jacob Ward to erect a paper mill and with rights to build a dam and mill pond. On June 12 of the same year, he paid Samuel L. Ward \$75 for sufficient land on the west side of the brook to build the dam and millpond.

By 1805, the paper mill, together with the dam, millpond, raceways, etc., had been built. In June of the same year, Isaac Dodd, Jr., brother of Abijah Dodd, bought a two-third interest in the mill for \$200, and in July sold one-half interest to Henry C. Southwick of New York City for \$2,000, accepting a mortgage for the full amount. On July 15, 1806, Isaac Dodd, Jr., purchased the remaining one-third interest from Baldwin for \$1,250, and in October, both Dodd and Southwick sold the mill and property to John Purvis, Alexander Wilson, and Robert Laing, described as "papermakers," for a total of \$4,000.

The original apprenticeship papers of Isaac, son of Abijah Dodd, and nephew of Isaac Dodd, Jr., to Purvis, Wilson and Laing, dated January 31, 1808, when Isaac was fifteen years of age, are in the possession of Howard Dodd, Jr., a direct descendant and resident of Glen Ridge. The apprenticeship was to last five years, seven months, and 12 days, and Dodd was "to be taught the trade or mystery of papermaking."

In 1812 Robert Laing sold his interest to his two partners for \$1,300. Since Laing's wife, Harriet, did not sign the deed transferring the title, in 1814 the two partners had to pay her a further \$1,500 to clear the title.

On May 10, 1816, the mill property plus two other lots were sold to Isaac J. Ward and Israel Downs for \$8,500. The next day Israel Downs sold his half-interest in all the properties to Isaac J. Ward for \$4,520. Ward operated the mill until February 2, 1832, when it was sold to James Gardner Moffett for \$5,500.

Moffett was born in New York City on August 4, 1801. At the age of twelve he apprenticed to Thomas S. Uffington of Belleville, a manufacturer of whalebone, slat ribs, and fastenings for umbrellas. In 1829 Uffington went into bankruptcy when he was unable to pay debts totaling \$30,849.16. Moffett purchased the mill in order to go into the manufacture of rolled and sheet brass. Uffington was associated with him in the mill operations until his death a few years later, at which time Moffett started the manufacture of German silver and other metal platings. Samuel Benson, the brother of Moffett's wife, Maria, was also associated with the business until he opened his own rolling mill in 1852.

The mill was originally operated by water power, and the first roller was only 12 by 24 inches. However, as business increased it became necessary to install steam power and modern equipment. Business continued to increase, and, at its peak, shipments were made to all the principal markets in the United States and Europe. At that time, the mill produced a very large income for its

owner. In 1845 Moffett purchased an additional acre and one half from the estate of Isaac J. Ward for \$90. This property was next to the mill property and was downstream between the turnpike and the brook.

In 1858, Moffett went into bankruptcy, unable to pay debts of \$17,299.76 and the mill property was sold at auction to Thomas Dusenbury of New York City, one of his creditors. On December 30, 1861, Moffett repurchased the mill property from Dusenbury for \$3,512.16 and re-established the business to manufacture copper for the government. This business survived until 1878, and Moffett himself operated the mill until his death on January 13, 1887 at the age of 85. In all the official records, Moffett, is listed as a resident of New York City and apparently maintained a summer home in Bloomfield.

On his death, his son, James took charge of the mill. He continued the operation of the mill until his death on September 15, 1897, at the age of 61. In 1899, Mary A. Maxwell, executrix of his estate, obtained permission from the Orphan's Court of the County of Essex to advertise the mill property for sale at auction. Previous to this, sentiment had developed that the Glen should be protected from commercial development. The announcement of the auction and rumors that a potential purchaser was planning to build a resort park on the mill property caused a public meeting to be called. At the meeting a committee of six headed by Mayor Rudd was formed to bid on the property on behalf of those present. The committee was the high bidder at the auction and purchased the mill property for \$9,000 on June 29, 1899. The Glen Ridge Park Association was then formed to buy as much of the Glen as it could, until the Borough or county was in a position to buy it at cost for a park. The mill property was transferred to it at cost on December 31, 1900, and the Borough of Glen Ridge purchased it on December 9, 1901.

The mill and the other buildings were torn down shortly after this, although the dam and water wheel survived for several years. The water wheel was destroyed by fire started by sparks from a locomotive, and the dam was undermined by a series of floods and finally swept away. All that remains is a part of the dam on the north side of the brook. The existing massive stone foundations further down the brook, opposite Herman Street, were erected by Moffett to support his barn and stable.

THE HAYDEN MILL While the mill once located where Hurrell Field is now was known as Hayden's Mill, the land was originally owned and the mill built by Samuel Benson.

Benson had been manufacturing sheet brass on the opposite side of the Newark and Pompton Turnpike since 1832, but in 1852 he built another mill on land he had bought from the Cadmus family across the turnpike. This mill was located to the west of the present Arcade where the east bleachers and the field house of Hurrell Field now stand.

On March 2, 1863, Benson sold his mill to Peter Hayden for \$11,000, the transaction being made for three separate parcels of land coming to almost one and one-half acres of property. Benson remained at the Hayden Mill as a

manager until 1875, when he retired. By 1895, Hayden had established a successful business making castings which were used in the manufacture of harnesses.

Peter Hayden died at the turn of the century, and on May 28, 1901, his wife, Sarah Hayden, acting as executrix for his estate, sold the harness factory to Thomas Alva Edison and his wife Mina. (Edison was no stranger to Glen Ridge, already owning at that time an ink factory on Midland Avenue where it is believed he formulated the idea for waterproof ink.) Edison bought the factory and surround land for \$19,000.

Edison installed the Edison Storage Battery Company in the factory, where he experimented on a storage battery for electric carriages. Dana Mitchell, a longtime resident of the Borough, recalls Edison's electric automobile being towed through the streets by a horse when the battery went dead.

In 1924, the Edison factory was demolished and the land was acquired by the Borough to provide the first high school athletic field.

THE BENSON MILL One of the more successful of the mill owners was Samuel Benson who had emigrated from Belleville in 1832. He entered into the manufacture of sheet brass with James G. Moffett at a plant located on the southerly side of Bloomfield Avenue and subsequently known as Moffetts Mill. In 1852, Benson built a second mill on the north side of Bloomfield Avenue for the refining and rolling of sheet silver. He later sold the business to Peter Hayden.

When he was 67, Benson built his third mill to manufacture sheet and rolled brass in Glen Ridge in 1878. Located at the corner of Sherman and Belleville Avenue, it is now Clay Field. At this last plant, the Benson family had a process for making silver-plated copper for reflectors in carriage lamps which they used extensively. Benson continued to run the mill until he died in 1882. Afterward the business was carried on by his son, Henry King Benson who had entered the rolling mill in 1859, at seventeen, to assist his father and to become familiar with the work involved. In 1887, the mill was renovated; a 125 horse power engine was installed.

During that time a non-sectarian Sunday school was also held in the workrooms there with all the greasy machinery around and scraps of metal in piles. Dana Mitchell, local resident and an editor of the New York Sun, was to recall years later, "I regret that some of us boys paid more attention to the mill machinery and the large tanks filled with acid than we did to our Sunday school lessons." In 1888, when the Congregational Church was organized in Glen Ridge, the religious services were held in the railroad station. The Sunday school gave up its quarters and also moved to the depot.

Frank Benson entered the family business in 1888, joining his brother as a partner for \$5,000, after which the firm continued under the title of H.K. & F.S. Benson, successors to the late Samuel Benson. By 1898, twenty men were employed there. On the fourth of July, while the Benson mill would be closed the men who worked there had to mow the field around the Benson home.

When Frank Benson died in 1923, his brother and his widow incorporated the mill and deeded the property to the Benson Rolling Mills, which continued to manufacture sheet brass until Henry Benson died in 1928. The plant was then rented to the Hadden Saddlery Harness Company. The last product manufactured there was flit guns.

Further evidence of this reversal of ordinary community development was the purchase of the mill from the Benson Rolling Mills Corporation by the Board of Education under Clayton Freeman in the spring of 1932 when bonds were issued to the amount of \$36,000. Subsequently the mill was demolished so that the site could be used temporarily for a parking lot and then later for a new borough high school. Plans for a school on this site did not materialize, and in 1967, the Board of Education deeded Clay Field to the Borough for the sum of one dollar. Subsequently, paddle tennis courts were built in the site. The Benson family were successful entrepreneurs but also were an integral part of the public life in Bloomfield and Glen Ridge, particularly when Glen Ridge became a Borough apart from Bloomfield. The earliest official record of election in Bloomfield is that of 1871, when Samuel Benson was an elected member of the town committee. It was later held by his sons, Henry and Frank Benson, both of whom served the Borough, Henry on the Board of Health and Frank as tax collector. Frank Benson's wife, Helen Wilcox Benson, was also active early in the Borough's history in literary endeavors.

A portrait of Samuel Benson's two daughters, Harriet and Margaretta, hangs in the library's main reading room. It was painted in about 1865 in the American Primitive style, and the artist is unknown.

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AS OF JANUARY 10, 2017:

OWNER INFORMATION

Owner Name: BOROUGH OF GLEN RIDGE
Owner Address: PO BOX 66
GLEN RIDGE, N.J. 07028

PROPERTY INFORMATION

Property Location BLOOMFIELD AVENUE
County 07 - Essex
District 08 - Glen Ridge Boro
Block Number 76
Lot Number 12
Qualifier
Property Class 15C - Exempt Public Property
Land Description 517X425
Building Description B
Acreage 5.0442

Land Value 4,129,500
Building Value 375,800
Net Value 4,505,300

Prior Year's Taxes \$0.00
Prior Year's Net Value 4,505,300

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FEATURE ARTICLE

Thomas Edison as a Manager of R&D: The Case of the Alkaline Storage Battery, 1898–1915

W. Bernard Carlson

Abstract — From 1898 to 1915, Thomas Edison devoted the resources of his laboratory at West Orange, New Jersey to developing an alkaline storage battery. Initially, Edison intended that this battery would be used in electric automobiles, but technical problems prevented him from introducing his battery before this market disappeared. This article argues that in the course of this invention Edison modified his style and approach. In particular, Edison became less of a tinkerer and more of a research director supervising a team of college-trained chemists and engineers. As a research director, Edison motivated his experimenters by using informal management techniques and he insisted on keeping research closely connected to manufacturing. But most of all, his approach shifted from being “divergent” in which he tried many solutions to being “convergent” in which he directed experiments toward a highly specified goal.

For many Americans, Thomas Edison will always be the “Wizard of Menlo Park.” When we think of Edison, we conjure up the image of a scruffy fellow working into the night in quest of a better mousetrap. Although a talented experimenter himself, Edison in our memories is assisted by a faithful crew of ruffians and mechanics. This crew pursued numerous simultaneous experiments, yet somehow by informal banter, practical jokes, and an occasional bet for a cigar, Edison guided their efforts and invented revolutionary technology. Often Edison and his team produced new inventions on a limited budget and in only a few weeks; hence it is not surprising that contemporary newspaper reporters invoked magic and wizardry to explain Edison’s work at Menlo Park.

Underlying this image of Edison as the “Wizard of Menlo Park” is a romantic view of invention. [1] Invention is uncontrollable, unpredictable, and ultimately, unmanageable. It is based on genius and luck, both of which Edison claimed to have in abundance. When the muses of invention spoke, they spoke; when they were silent, they were silent, and no amount of management, bureaucracy, or procedure could force them to reveal their secrets.

Although this romantic view of invention may well describe Edison at Menlo Park in the 1870s, it does not represent the mature Edison at West Orange in the 1900s. At Menlo Park, Edison may have permitted too much chaos and disorder, but it was perhaps necessary in order to create revolutionary technology. In contrast, at West Orange Edison modified his style of invention to suit the challenges of twentieth century business. Edison’s approach shifted from being informal and craft-based to being routinized, formal, and science-based. Rather than turning out inventions in days and weeks on a

This paper is based on research conducted under contract for the National Park Service and I am grateful for their support. I conducted this research jointly with A. J. Millard of Bentley College. A portion of this paper appears in Dr. Millard’s unpublished manuscript, “A History of Edison’s West Orange Laboratory, 1887–1931.” I wish to thank Edward J. Pershey, Mary B. Bowling, and Eric Olsen of the Edison National Historic Site for their assistance in working with the Edison archives. An early version of this paper was presented in the Social and Decision Sciences Department, Carnegie Mellon University, Pittsburgh in October 1986. This present version was completed with the support of a summer research grant from the University of Virginia. I wish to thank George Wise and an anonymous referee for their help in substantially improving both the content and style of this paper.

shoestring, Edison chose large, capital-intensive projects that took years and decades. Instead of trying many divergent solutions to solve a technical problem, he now had his staff converge on a single design. And Edison himself became less of a tinkerer and more of a research director who supervised a large staff. Although this transformation in Edison’s style of invention began when he moved to West Orange in 1887, these changes fully manifested themselves in his efforts to develop an alkaline storage battery from 1898 to 1915. Through the story of the storage battery, one can see that Edison was not just a heroic inventor but also an effective manager of R&D. [2]

TAKING UP THE ALKALINE STORAGE BATTERY —

Like other inventions developed at his West Orange laboratory, the storage battery was an idea that Edison had when he established the lab in 1887. At that time, Edison was struggling to find a power source for the electric motor he was then using in his phonograph. Edison and his associates experimented extensively with non-rechargeable or

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primary batteries using copper oxide and zinc plates immersed in a liquid electrolyte of caustic soda or sodium hydroxide. Edison began manufacturing these cells in 1889 at his Silver Lake chemical works in Bloomfield, New Jersey. Edison and his staff also investigated rechargeable or storage batteries for the Edison Electric Light Company that was interested in using cells to store power for consumption during peak demand. These battery investigations continued throughout the 1890s, forming a body of knowledge that Edison could exploit when the opportunity arose. [3]

That opportunity came in the late 1890s, in the wake of Edison's last unsuccessful efforts with iron ore separation. [4] As it became clear that iron ore prices would never be high enough to permit profitable operation of the ore separation plant, Edison revived his old ideas about a better storage battery. Edison wanted to invent a storage battery that was genuinely rechargeable and that efficiently converted chemical energy into electrical power. "A storage battery," he declared, "...should be a perfectly reversible instrument, receiving and giving out power like a dynamo motor, without any deterioration of the mechanism of conversion." [5]

From the outset, Edison's interest in an efficient rechargeable cell was closely related to the development of an electric vehicle. From 1895 onward, America entered into an automobile craze, with the popular press celebrating every invention related to the automobile. Many prominent inventors, including Elmer Sperry and Elihu Thomson, were attracted to the excitement surrounding the automobile and developed their own vehicles. The potential of a self-propelled vehicle captivated Edison, too, and as early as 1896 he had the lab build a motorized tricycle. A little later, the Edison household acquired an electric carriage and in October 1899 Mrs. Edison requested that the lab build a garage for recharging this vehicle. [6] Experience with these vehicles apparently convinced Edison that the future belonged to the electric car and he began developing a battery for it. He was confident that a large and growing demand for his battery would offset the high R&D costs he might incur.

Since the electric vehicle was to be the major application for his new storage battery, weight became an important consideration. Although storage batteries employing lead electrodes and an acid electrolyte had been available since the 1860s, Edison believed that they were too heavy and uneconomical for use in automobiles. Edison decided to develop a substitute and "produce a practicable battery which will permit the storage of a large[r] amount of energy per pound of material than is possible with the type of battery using lead electrodes." Edison was confident that there had to be an electrochemical combination that avoided using a metal as heavy as lead, and he intended to find the ideal combination. As he observed, "I don't think Nature would be so unkind as to withhold the secret of a good storage battery, if a real earnest hunt were made for it. I'm going to hunt." [7]

A CONVERGENT RESEARCH STRATEGY, 1899-1904 _____

Edison started his hunt for a new battery in 1898 not with random experiments in the laboratory but with a thorough

search of the technical literature. Just as he had done at key stages in developing his electric lighting system, Edison had his assistants pore over scientific and engineering journals to collect information from American, English, French, and German sources. Through this search, Edison learned that other inventors and scientists had identified alternatives to the lead-acid battery and he kept their work in mind as he undertook his own investigations. [8]

After searching the literature for about nine months, Edison was ready to begin experimenting. In the spring of 1899, he assembled a research team by selecting men already at work at his West Orange laboratory and by hiring a new group of professional chemists and engineers. With its preponderance of experimenters trained in science, the storage battery project differed from previous inventions for which Edison had relied heavily on craftsmen and mechanics. Consisting of about a dozen experimenters, this team worked primarily in the chemistry laboratory (Building 2), where each man was assigned a table. For his own experiments, Edison set up a laboratory bench in the back room of this building. [9]

Edison started the team off by having them investigate the familiar electrochemical combination of the primary battery that he was manufacturing at his Silver Lake chemical works. Edison had his researchers vary one component of the cell and conduct experiments until they obtained optimal results. Generally, Edison and his assistants tested different materials for the components of the cell by packing the selected material into porous carbon electrodes that were then placed in a test tube filled with the electrolyte, thus forming a small battery. Following this strategy, Edison and his staff investigated several different electrochemical combinations from 1899 to 1904 (see TABLE I). [10]

In adopting this time-consuming, step-by-step approach, Edison was organizing his research in a new way. In particular, he defined the overall project as a set of small tasks. Previously, Edison had used teams of experimenters to pursue simultaneously several different solutions to a technological problem. For instance, with the electric light project, Edison and his men alternated working on the lamp, the dynamo, and the distribution network; he designed a coherent system, in part, because his team worked on all fronts at once. [11] Likewise with the phonograph in 1888-1889, Edison and his experimenters did not systematically modify each component in an orderly sequence but rather experimented simultaneously with record cylinders, recorders, reproducers, and duplicating techniques. [12] In these projects, Edison allowed his experimenters to pursue "divergent" solutions to different aspects of the system, thus insuring a range of creative responses. Eventually, Edison gathered these different ideas and shaped them into a coherent and successful invention.

In contrast to this free-wheeling and divergent approach, Edison organized the storage battery project as a "convergent" set of tasks. Edison assigned a specific material or arrangement to each experimenter who then conducted a long series of standard experiments until he secured the

TABLE I
FLOW CHART OF EDISON'S RESEARCH ON THE STORAGE BATTERY, 1899-1909

Year	Anode	Electrolyte	Cathode
1899	Zinc	Sodium Hydroxide	Copper Oxide
		Potassium Hydroxide (used in all subsequent batteries)	Silver Oxide
1900	Cadmium (too expensive)		Copper Compounds
			Cobalt Oxide (too expensive)
1901	Iron (used in all subsequent batteries)		Nickel Oxide
1903		Type E Cell	
1904		(leaks & capacity drops)	
1905			Cobalt Oxide (still too expensive)
			Nickel Oxide & Nickel Flake
1909		Type A Cell	

Richard H. Schallenberg, *Bottled Energy: Electrical Engineering and the Evolution of Chemical Energy Storage*, Philadelphia: American Philosophical Society, 1982, pp. 355-366.

best possible results. Edison reviewed the results of different chemists and chose the material for that particular component. Edison and his team then moved to the next component or problem and attacked it in the same way. In taking this approach, Edison was able to investigate thoroughly a number of electrochemical combinations and determine which one best suited his purposes. Furthermore, he was able to build on the results of one series of experiments, and thus converge on an ideal design for his battery.

Although this convergent approach produced highly reliable results, it came at the cost of requiring over 50,000 individual experiments. [13] Furthermore, Edison had thoroughly routinized the innovation process. By breaking down the research into a sequence of small, standardized experiments, Edison had altered the creative process from hands-on ingenuity and skilled observation to persistence and careful record-keeping. Gone were the last vestiges of the "heroic" myth of invention in which insight came in a blinding flash; results now came by plodding through in-

numerable experiments.

By so deploying his scientific troops, Edison conducted a long series of electrochemical experiments and eventually chose to employ a combination of iron and nickel oxide in his cell. Pleased with the preliminary results obtained from this combination, Edison filed patents in March 1901. To generate capital for further research and development, Edison organized the Edison Storage Battery Company in May and sold these patents to this new company for \$1 million. [14]

With an electrochemical combination in hand, Edison decided that the next tasks were to improve the electrochemical qualities of nickel and iron and to determine the best form for the internal parts of the battery. By now, however, Edison and his team of chemists had been at work on the battery for over three years and had conducted thousands of experiments. To prevent boredom from setting in, Edison devised new ways to motivate his researchers. As Jonas W. Aylsworth, the chief chemist, recalled:

IEEE Technology and Society Magazine, December 1988

To stimulate us to greater improvement, Edison hung up a card which showed the results of tests in milliampere-hours given by the experimental elements as we tried them. . . . This stirred up a great deal of ambition among the boys to push the figures up. Some of our earliest tests showed around 300, but as we improved the material they gradually crept up to over 500. [15]

Clearly, Edison was not only capable of identifying the next task in the research campaign but he was also successful at introducing informal management techniques that motivated his team to complete these tasks quickly and successfully.

From improving the electrochemical properties of nickel and iron, Edison and his men moved next to designing the grids for the electrodes. Since the nickel oxide and the iron were to be finely powdered (in order to increase the area of surface contact between the electrodes and the electrolyte), it was necessary to design a special frame or grid to hold these materials. Like other steps in the storage battery project, the design of the grid pockets demanded numerous experiments and it took until 1904 to perfect this component.

After much experimentation, Edison settled on grids made of nickel-plated sheet steel formed into thin, flat pockets. In the pockets of the negative electrode went the iron powder while the pockets of the positive electrode were filled with nickel oxide. To improve conductivity in both electrodes, Edison mixed in graphite flakes. Edison dubbed this design the Type E cell. [16]

As the battery took shape, Edison turned to testing it. Determined to penetrate the electric vehicle market, Edison knew that his battery had to be rugged and reliable. To insure this meant extensive testing. To test durability, he had his assistants drop cells out the second and third floor windows of the lab. [17] For performance, Edison ordered his men to load cells into several different electric cars and trucks and then drive them over rough country roads in New Jersey for 5000 miles. So rigorous were these tests that if the car did not break down after several days of continuous running, Edison accused the driver of picking easy roads. [18]

MANUFACTURING AND MARKETING THE TYPE E BATTERY, 1903-1904

Even as research and testing continued, Edison began making plans for the manufacture of his alkaline battery. From the outset, Edison was anxious to reduce the price of his product, but to do so, he knew he would have to cut the cost of his raw materials. Consequently, from 1901 to 1903, he undertook an extensive search for sources of nickel, the most expensive material in his cell. Edison contemplated organizing his own company for mining and processing nickel ore, but he eventually decided that it was too risky to develop his own mines since he found it impossible to find reliable information about nickel deposits. Subsequently, Edison found it easier and cheaper to purchase this metal from producers. [19]

In May 1901, Edison established a battery assembly plant in an old brass rolling mill in Glen Ridge, New Jersey. Just

as he had done previously with his ore separation and Portland cement plants, Edison took great interest in planning the production processes and he sketched the plant layout in his notebook. In setting up this factory, Edison drew upon his established enterprises: from the laboratory came machine tools and patterns, from the Phonograph Works came hardware and steel, and the Edison Manufacturing Company supplied miscellaneous materials. Full scale production at Glen Ridge began in January 1903 and soon the plant was making 200 cells per week. These first cells cost less than \$10 to make and were sold for \$15.00. [20]

In preparation for marketing his new battery, Edison carefully studied his chief American competitor, the Electric Storage Battery Company. Through business contacts, Edison secured information about the design of this company's lead-acid cells and about their stock prices, number of workers, and sales volume. Edison also had his staff study their batteries. Drawing on this data, Edison was able to determine what points to raise in his marketing campaign. [21]

Throughout 1904, Edison mounted a media blitz promoting his new alkaline battery and attacking the lead-acid battery. He encouraged newsmen to describe his new product as clean, and free of the foul odors and dangerous acids of the lead battery. According to one report, Edison's new battery:

looked like a handsome little document-case, of shiny steel, neatly capped over with polished porcelain. There was no grime, no smudge, no suggestion of chemicals and currents; a battery of these cells would adorn a lady's boudoir.

In addition, Edison emphasized that his battery was practically maintenance free. "The only attention it needs is to be kept full of water. . . . Any coachman can care for it." [22] In making such claims, Edison wanted people to see his cell as modern and convenient. Thanks to this publicity campaign, the Edison Storage Battery Company enjoyed modest sales in 1903 and 1904, selling 14,000 cells for use in electric cars and trucks. [23]

GROWING PAINS, 1903-1908

Unfortunately, problems soon appeared. The battery leaked because the caustic electrolyte ate through the solder along the seams of the battery's outer steel can. More seriously, the electrical capacity of the cells dropped substantially after a number of charges and discharges. [24]

As customers reported these difficulties, Edison realized that he had not fully tested his new battery. It was simply not enough to drive a few cars around at high speeds or drop cells out of windows. From the outset of the project, Edison had been anxious to rush his battery into production, partly to offset his high R&D costs but also to counter the rival lead-acid battery manufacturers' head start in the electric vehicle market. Now it was clear that he had been too hasty in introducing this new and complex product. In November 1904, Edison shut down production at Glen Ridge and ordered all defective cells be bought back from the

customers. Production was eventually resumed, but only to manufacture replacement cells for established customers. Even though new customers were willing to buy the Type E cells, Edison refused to sell them an imperfect battery. [25]

At the lab, Edison immediately redeployed his staff and resources. At once, he had two rooms fitted up for battery experiments and he set up a special research team. "I have 12 young men & 6 workmen running curves on small cells," he wrote, "& everyday we expect to strike the bug." [26] Working night and day, Edison and this team conquered the leaky can problem in a few weeks. Instead of soldering the seams of the cans, Edison had his staffers design a machine for welding the cans. [27]

In producing this welding machine, Edison managed his staff by using competition and rivalry. Originally, Edison assigned the task to John Ott, head of the second floor machine shop. Ott was uncertain as to how to design the welder, however, and he hesitated. Even though Ott was a long-time associate, Edison took the assignment away from him and gave it to the foreman of the first floor machine shop. Anxious to please the "old man," the foreman turned out an excellent welder, "a finer machine than John [Ott] ever built." Sensing that Ott and the foreman were in competition with each other, Edison used this to his advantage to secure a good machine. As he remarked about the lab, "There is great rivalry which seems to be a good thing all around." [28]

The battery's declining electrical capacity proved much harder to diagnose and solve. Edison and his men tested hundreds of cells and broke up dozens more, trying to understand what was going wrong inside. Unlike previous challenges that Edison overcame by careful observation and experiment, the capacity problem remained an abstract one. As Edison observed, "In phonographic work we can use our ears and our eyes aided by powerful microscopes; but in the battery our difficulties cannot be seen or heard, but must be observed by our mind's eye." [29]

From 1904 to 1908, the capacity problem absorbed much of the lab's resources and personnel. To help with this problem, Edison advertised for chemists familiar with electrolytic analysis in the electrical journals and local newspapers. By July 1907, the Storage Battery Company employed 51 workers at the lab and 34 people in a separate Testing Department. Since the Storage Battery Company had no income, by 1910 Edison had personally spent \$1.9 million on these experiments. [30]

During this period, Edison was typically to be found working in the chemical laboratory, standing at a long lab bench covered with test tubes holding various electrochemical solutions; patiently and methodically, he tried hundreds of different combinations of electrodes and electrolytes, day in and day out. [31] To maintain his own morale, Edison kept in mind the great commercial potential of the battery and his desire for a high-quality product; as he wrote to Sigmund Bergmann, who was manufacturing the battery in Europe:

the moment we find the trouble we will let you know.
It will be plain sailing then & once we get it ok...the

business will be unlimited and very profitable BUT WE MUST HAVE IT RIGHT. [32]

As for Edison's assistants, they maintained their own morale by organizing "The Muckers of the Edison Laboratory." A social club, this group sought to "add a bit of the spice of life to the muck we make" by taking frequent trips into New York City to enjoy vaudeville theater, eating, and drinking. At their dinners, the Muckers frequently made jokes and puns about the chemicals used in the storage battery experiments and they always sent a note signed by all the members to the "old man" wishing him good health. [33]

Edison never let his men lose faith in their ability to overcome the capacity problem. When one chemist suggested that the situation was hopeless, Edison was quick to reply:

I've been in the inventor business for thirty-three years, and my experience is that for every problem the Lord has made He has also made a solution. If you and I can't find the solution, then let's honestly admit that you and I are damn fools, but why blame it on the Lord and say He created something "impossible?" [34]

Eventually, Edison and his "muckers" traced the capacity problem to the nickel oxide electrodes. During charging the electrodes swelled and during discharging they shrank. This continual mechanical movement reduced electrical contact between the nickel oxide granules and the grid pockets, thus increasing the internal resistance of the cell and lowering its output. In response, Edison made two modifications to the nickel oxide electrode. He replaced the flat pockets with round ones and he increased electrical conductivity with the new pockets by sandwiching thin layers of nickel flake with nickel oxide. To minimize expansion or shrinkage during charging or discharging, Edison designed machinery that tamped down these layers with a mechanical force of 200 psi. [35]

MANUFACTURING AND MARKETING THE TYPE A CELLS, 1908-1915

Edison christened his new battery with the nickel flake and round pockets the Type A cell. Through 1908 and 1909, Edison had this new cell thoroughly tested and found that he had raised the capacity of his battery from 10.2 to 14 watt-hours per pound of battery, and that the new battery's charge could outlast that of the best lead-acid batteries. [36] Delighted with these results, Edison resumed full-scale manufacture and marketing.

As the laboratory research wound down, Edison again redeployed his staff and resources to manufacturing and marketing the new battery. Still anticipating a huge demand, Edison supplemented the Glen Ridge factory with a new battery plant. Located across the street from the laboratory, this new factory contained nine acres of floor space. Although production began in 1909 with only 100 cells a day, Edison hoped that production might reach a million cells per day. [37]

With the new plant in place, the Storage Battery Company sold over \$1 million worth of batteries in 1910. However,

IEEE Technology and Society Magazine, December 1988

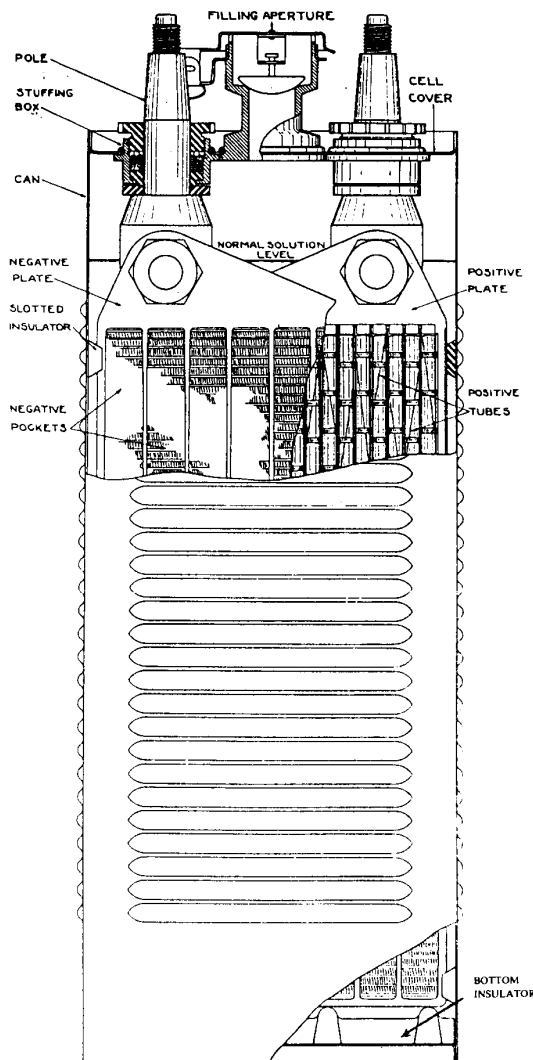


Fig. 1. Plan of Edison Type A Cell, circa 1908-1915. Note that a typical cell would have several sets of negative and positive plates arranged alternately. A version of this cell is still manufactured today. From Negative 775, Edison National Historic Site, West Orange, New Jersey. My thanks to Eric Olsen for locating this plan.

because of the enormous debts incurred in developing the battery and building the new factory, the Storage Battery Company continued for the next few years to be a drain on the resources of the Edison business organization. To help offset these heavy debts, Edison strove to reduce his production costs and market his new battery aggressively. [38]

Unlike other inventors who left the problems of production to engineers and managers, Edison took an active interest in the production of his inventions. In fact, he assumed that an invention was not finished until it was being manufactured at a reasonable cost. As a manufacturer, Edison was guided by two straightforward considerations. First, he insisted on developing a high-quality product. Throughout the storage battery campaign, Edison was deter-

mined to surpass the lead-acid cell with a superior product. Notably, this insistence on quality became one of the hallmarks of many of Edison's inventions in the twentieth century such as the disk phonograph and well-designed consumer appliances. [39]

Second, Edison always sought to reduce his costs of production. No invention was successful unless it was profitable, but to do so Edison refused to cut corners on product quality. Instead, he made his products competitive by trimming manufacturing costs. In the case of the storage battery, he began with a high-quality and expensive design that he strove to make competitive by looking for cheap sources of raw materials, by developing new processing techniques, and by designing special purpose machinery for assembly. Furthermore, Edison controlled his costs by vertically integrating his operation; rather than depend on outside firms for any aspect of the battery enterprise, Edison set up facilities for every step, from processing nickel and iron powder at his Silver Lake chemical works to marketing and servicing cells. In pursuing a policy of vertical integration, Edison's business strategy paralleled the practice of other business firms in the late nineteenth and early twentieth centuries. [40]

Not only did Edison integrate backwards by undertaking all aspects of battery production, but he looked forward toward the markets and applications of his battery. With characteristic exuberance, he predicted that "inside of 15 years the entire vehicle traction in large cities in the United States will be done electrically & I am now manufacturing the battery that will permit this to be brought about commercially." [41] To secure sales contacts and marketing data, Edison sent men to state licensing bureaus to collect the names of electric vehicle owners. Unfortunately, these investigators found that by 1910 electric vehicles had begun to lose out to gasoline-powered cars. In New Jersey for example, while 800 electrics had been licensed between 1899 and 1906, 98 percent had been abandoned by 1910. [42] "The record is bad," admitted Edison, but it was

not the fault of the vehicle but the lead battery. . . . A great deal of work will have to be done by all of us to remove the bad impression. A satisfied & delighted customer is the only method that will build up a permanent business. [43]

Try as he might, Edison was never able to remove the negative impressions associated with the electric car. The American public favored the gasoline car with its cheaper fuel, higher speeds, and wider cruising range. As a result, Edison was forced to look for new markets for his battery.

The bustling city seemed especially promising. The first new market Edison identified was the electric delivery trucks used by department stores. Edison felt electric trucks were ideal for intra-urban service since they could make their rounds by day and return to the garage at night for charging. Unlike gasoline trucks that had to be cranked to start, the electrics could be easily started and stopped for quick deliveries. Through the 1910s several New York stores (including Tiffany's and Altman's) used electric trucks with Edison batteries. With the introduction of the electric starter

for the gasoline engine in 1912, however, electric trucks lost much of their advantage. [44]

Edison also pushed for a battery-powered streetcar. Such cars were desirable for rush hours on mass transit systems since they did not use additional power from the main generating station and hence did not require expansion of the transit system's power plant in order to meet an increased peak load. (Indeed, they could be charged late at night when the load on the system was the smallest). To develop this application, Edison built a short railway line near the laboratory during the winter of 1909-1910. To manufacture a special car, Edison gave a former General Electric engineer, Ralph H. Beach, the exclusive right to build streetcars using his battery. Beach established a factory adjacent to the Silver Lake chemical works. Unfortunately, after three years, the project died because Beach was unable to build a sales organization to promote the car and he failed to pay his debts to his suppliers. [45]

Despite Edison's best efforts to promote the electric car, truck, and streetcar, their use was limited by the technical characteristics of the alkaline cell. While the alkaline battery's active materials (nickel, iron, and nickel oxide) were lighter than lead, the weight saved was offset by the complex scheme of pockets and electrodes inside and the alkaline cell consequently outweighed its lead-acid rival. [46]

Beyond this unfavorable weight comparison, Edison was unable to bring the alkaline battery's cost below the lead battery's. By his own estimate, his alkaline cells cost twice as much as the competing lead batteries. Here the problem was not so much the cost of the materials but the expense of assembling a battery with several dozen small tubes filled with thousands of layers. Edison maintained that his battery was cheaper to operate and service, giving it a lower cost per kilowatt-year. Nevertheless, Edison knew that the price of his battery was a serious problem and he continually sought to reduce production costs. [47]

Finally, Edison's battery did not work well under all conditions. At low temperatures, the electrolyte became weak and slushy and electrical capacity fell. Furthermore, unlike the lead battery that can be designed to give a short, high current discharge, the alkaline cell was best suited for long, low current discharges. For this reason, the alkaline cell did not lend itself to many applications, including the electric starter for gasoline cars. However, the alkaline cell could hold its charge for long periods of time and it was much more rugged than the lead-acid battery. [48] Hence, while not suited for certain jobs, there were other applications for which the alkaline battery was highly appropriate, and Edison threw himself into the task of identifying these new uses.

In some ways, the storage battery campaign had gone the same way as the ore separation venture; Edison had begun by assuming that a large market existed for his product, only to discover that the market shifted during the long years of development. But unlike ore separation, Edison persevered, and from 1910 to 1915 he cultivated new markets for his battery. With the assistance of Miller Reese Hutchison, Edison pursued military applications. Having served as an electrical engineer in the United States Lighthouse Service,

Hutchison had numerous contacts in the Navy and among officials in Washington. [49] Through his contacts and skillful preparation of advertisements, Hutchison arranged for the Edison battery to be used to power submarines, torpedoes, wireless sets, and electric motors on battleships. Although these military uses brought profits into the company, the most promising application, submarines, proved disastrous. In January 1916, Edison cells were installed in the U.S. Submarine E-2 that exploded while in drydock in the Brooklyn Navy Yard. Although the explosion was probably due to the crew failing to open a hatch and vent the battery gases, the Navy subsequently demanded stringent testing of batteries that prevented further use of Edison batteries in submarines. [50]

This disaster, however, did not set Edison back; while Hutchison had pursued the military market, Edison had promoted his battery for other uses. Optimistically, he made one list in 1911 of 64 different applications, including many of the tasks to which the alkaline battery was successfully applied: lighting railway cars; providing back-up power for generating stations, lighthouses, miner's lamps, and railroad signals; and lighting isolated houses and yachts. In addition, the list reveals several new applications for electricity, and Edison had his men experiment with a battery-powered bicycle, plow, and lawn mower. Sensitive to America's growing appetite for energy, Edison even dreamed of using the storage battery to accumulate power from the sun, tides, wind, and rivers. [51]

Thanks to these diverse uses, the Edison battery eventually proved to be a commercial success. Until 1960, the McGraw-Edison Company manufactured the battery using the production techniques designed by Edison and his team in the 1910s. Since then, ownership of the Edison battery and related alkaline battery technology has changed corporate hands several times, but the basic ideas of Edison's storage battery continue to influence the design and manufacture of contemporary industrial alkaline batteries. [52]

CONCLUSION

Edison's campaign for the storage battery reveals much about how he transformed the invention process at the West Orange laboratory during the first decade of the twentieth century. Whereas he had used mechanics and craftsmen to pursue earlier inventions such as the phonograph and kinetoscope, Edison developed the storage battery by drawing on a team of trained chemists and engineers. With the mechanics, Edison had taken a divergent approach, encouraging them to investigate all aspects of an invention; only at the appropriate moment did Edison, the master mechanic, pull together the various discoveries and improvements into a successful invention. In contrast, with the battery Edison carefully assigned each "mucker" his task and exhaustively studied each component of the cell. In taking this step-by-step approach and building upon the results, Edison converged upon the design of his battery.

In shifting from a "divergent" to a "convergent" style of research management, Edison altered his role within the laboratory. Whereas previously he had been just "one of

the boys,” or the “head mucker,” in the storage battery campaign he became a project manager. To be sure, Edison performed a large number of battery experiments on his own, but his major task was to oversee the project. Like the principal investigator of the contemporary research project, Edison monitored each experimenter’s line of research, identified trends, and shifted researchers to the most promising leads. He also regularly compared the laboratory results with commercial considerations, watching for the right combination that could be put into production quickly. Most importantly, as a project manager Edison motivated his research team. In the midst of long runs of routine experiments, he spurred his chemists on by challenging them to beat the posted number. Similarly, he always encouraged his staff to believe they could master the battery. Because his techniques in motivating and directing his team were decidedly informal, they have often been overlooked; yet Edison’s use of a personal, folksy style may well have been deliberate. [53]

Although his informal management techniques made it seem like the old days of Menlo Park, as Edison took up the convergent approach and assumed the role of project manager, the character of the innovation process was irrevocably altered. Invention was no longer a mysterious, seat-of-the-pants affair; it became an orderly, predictable process that got results from a long series of experiments. In many ways, the convergent approach was appropriate for the large scale of West Orange. With this approach, Edison made efficient use of his large staff and substantial facilities. He also believed that this approach would sooner or later produce a marketable battery. The orderliness and routinization indicate that Edison had made the innovation process a reliable component of business strategy. Like the manager of a German chemical works that had routinized dye research, Edison could look with pride at his West Orange lab and say “Nowhere [is there] any trace of a flash of genius.” [54]

Another important aspect of the storage battery project is that it shows how Edison actively moved his inventions from the laboratory to full-scale manufacture and distribution. Edison’s rule was to think about production early and often. No sooner than he secured positive results than he filed patents, organized a company, and began planning the factory. By keeping production always in mind, Edison prevented his staffers from pursuing false leads and thus sped up the research process. Furthermore, in establishing his factory, Edison sought to cut costs and integrate his operations vertically; clearly Edison was a savvy and up-to-date manager. While Edison had initially hoped that his battery would be used in electric automobiles, he quickly identified new applications for his battery when the electric vehicle market disappeared. In all of these ways, we see that Edison was not only an effective manager in directing innovation within the lab but also in seeing his inventions through to commercial success.

Finally, the story of the alkaline storage battery shows that Edison possessed a style of R&D management that is still relevant today. Significantly, the practices of con-

temporary Japanese high-tech firms resemble Edison’s approach. Like Edison, the Japanese have been successful in consumer electronics and other fields by using highly organized and motivated teams, linking R&D with manufacturing, and insisting on quality. Indeed, one might argue that if more American firms in the 1960s had organized their research efforts like Edison and avoided creating “ivory tower” labs isolated from production, they might have done better in competing with the Japanese. [55] Thus, although it is tempting to romanticize Edison as the “Wizard of Menlo Park,” we would do far better to study his career for insight into how R&D can be effectively and creatively managed.

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Unless otherwise noted, all documents are from the archives at the Edison National Historic Site, West Orange, New Jersey.

Abbreviations used:

LB year/month/day: letterbook with date of first entry

Ed. SB Co.: Edison Storage Battery Company

N year/month/day: laboratory notebook with date of first entry

SB: storage battery

TAE: Thomas A. Edison

WO: West Orange

- [1] Wyn Wachhorst, *Thomas A. Edison: An American Myth*, Cambridge: MIT Press, 1981, pp. 19–32 and pp. 37–40.
- [2] In describing Edison’s management style, I am following the tradition begun by Thomas Hughes of interpreting inventors as rational actors who shaped and controlled their creations and their environment. Inventors may be lucky in their discoveries, but more importantly they know what to do when luck strikes. They know how to impose order and structure on a new idea. See Thomas P. Hughes, *Elmer Sperry: Inventor and Engineer*, Baltimore: Johns Hopkins University Press, 1971 and “Edison’s Method” in W.B. Pickett, ed., *Technology at the Turning Point*, San Francisco: San Francisco Press, 1977.
- [3] On Edison’s work on primary cells, see Frank J. Priol, *Seventy-Five Years of Packaged Power: Primary Battery Division—Thomas A. Edison Industries*, Bloomfield, N.J.: McGraw-Edison, 1964, 13; N870301, N880610, N880103, N921109; see also the following shop orders: 28 “Storage Battery,” (Jan. 1888); 288 “Testing storage cell for E.L. Co.,” (ca. May 1889); 300 “New battery for phonograph to run 200, 400, & 600 hours,” (June 1889); and 496 “Test of 2 English Storage Cells” (Dec. 1890) in N871124.
- [4] W. Bernard Carlson, “Edison in the Mountains: The Magnetic Ore Separation Venture, 1879–1900,” *History of Technology* 8:37–59, 1983.
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- [6] Hughes, *Sperry*, pp. 80–89; Pope Mfg. Co. to TAE, Feb. 21, 1899; *New York Tribune*, June 25, 1899; Shop order 957, “Charging house for elec. carriage, Mrs. Edison,” ca. Nov. 1899, N871124.
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- [9] Shop order 935 “Storage Battery (Personal TAE),” June 1899 in N871124; “Minutes of the Mucker Society of Thomas A. Edison Laboratory at Orange, N.J.,” Cat. 1269, pp. 215–217; N020617.
- [10] For more information on the chemical research conducted by Edison and his staff, consult Schallenberg, *Bottled Energy*, pp. 355–364.
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- [12] Mark E. Ham, “Edison and the Phonograph, 1877–1889,” unpublished report prepared for W. B. Carlson and A. J. Millard, West Orange

- Lab History Project, 1986, p. 10.
- [13] Dyer and Martin, *Edison*, 2:561.
 - [14] See the following U.S. Patents granted to TAE for "Reversible Galvanic Batteries:" 678,722 (filed Mar. 1, 1901, granted July 16, 1901); 701,804 (filed Mar. 1, 1901, granted June 3, 1902); 704,304 (filed Mar. 1, 1901, granted July 8, 1902); 700,137 (filed Mar. 5, 1901, granted May 13, 1902); 700,136 (filed Mar. 5, 1901, granted May 13, 1902); TAE to Bergmann, July 26, 1905. On the formation of Edison SB Company, see H. F. Miller to A. J. Clymer, n.d., 1910 SB, Experiments and Tests, 2 of 2 file.
 - [15] "Edison's Alkaline Storage Battery," Meadowcroft Box 73.
 - [16] Arthur E. Kennelly, "The New Edison Storage Battery," *Trans. AIEE* 18: pp. 219-230, 1901.
 - [17] TAE's notes in 1903 SB, TAE's Notes file.
 - [18] Edison Storage Battery Co. to J. T. Mann, June 10, 1902, 1903 SB, Ed. SB Co. file; *NY Sun*, June 8, 1902; Dyer and Martin, *Edison*, 2: 565.
 - [19] TAE notes in 1901 Nickel Search file; F.R. Hanna to TAE, n.d., 1903 Nickel Search, Mines & Minerals file.
 - [20] N010420; Charles Batchelor Diary, Cat. 1345, pp. 254-255; W. Mallory to Caskey, Apr. 23, 1902, 1902 SB, Ed. SB Co. file; and TAE to Dick, n.d., 1903 TAE Handwriting file.
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 - [41] P. Manoury to TAE, May 6, 1908, 1908 SB, TAE's notes file.
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 - [43] TAE to Carlisle, June 22, 1910, 1910 Auto, TAE's handwriting file.
 - [44] TAE to Insull, June 20, 1910, LB100521, 204-205; TAE, Draft of "Talking Points" for selling electric trucks, 1910 SB, Wagons and TAE notes file.
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 - [53] For further discussion of Edison's informal management techniques, see W. Bernard Carlson and A. J. Millard, "Edison as a Manager of Innovation: Lessons for Today," *New Jersey Bell Journal* 8:24-32, Winter 1985-1986.
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**NOT FOR PUBLICATION WITHOUT THE
APPROVAL OF THE APPELLATE DIVISION**

This opinion shall not "constitute precedent or be binding upon any court."
Although it is posted on the internet, this opinion is binding only on the
parties in the case and its use in other cases is limited. R. 1:36-3.

SUPERIOR COURT OF NEW JERSEY
APPELLATE DIVISION
DOCKET NO. A-0593-15T1

COOPER INDUSTRIES, LLC,

Plaintiff-Respondent,

v.

COLUMBIA CASUALTY COMPANY and
ONE BEACON AMERICA INSURANCE COMPANY,

Defendants-Appellants,

and

EMPLOYERS INSURANCE OF WAUSAU,
ALLSTATE INSURANCE COMPANY,
LEXINGTON INSURANCE COMPANY and
WESTCHESTER FIRE INSURANCE COMPANY,

Defendants.

Argued telephonically March 15, 2017 –
Decided April 13, 2018

Before Judges Fuentes, Carroll and Gooden
Brown.

On appeal from Superior Court of New Jersey,
Law Division, Hudson County, Docket No.
L-2471-13.

Karen H. Moriarty and Clinton E. Cameron (Troutman Sanders, LLP) of the Illinois bar, admitted pro hac vice, argued the cause for appellants (Coughlin Duffy, LLP, and Clinton E. Cameron, attorneys; Suzanne C. Midlige, Timothy P. Smith and Karen H. Moriarty, on the briefs).

Michael D. Lichtenstein and Michael H. Ginsberg (Jones Day) of the Pennsylvania bar, admitted pro hac vice, argued the cause for respondent (Lowenstein Sandler, LLP, and Michael H. Ginsberg, attorneys; Michael D. Lichtenstein, Catherine M. Aiello, Michael H. Ginsberg, and Dominic I. Rupprecht (Jones Day) of the Pennsylvania bar, admitted pro hac vice, on the brief).

The opinion of the court was delivered by
GOODEN BROWN, J.A.D.

Appellants, Columbia Casualty Company (Columbia) and OneBeacon Insurance Group (OneBeacon), appeal from the June 12, 2015 Law Division order granting summary judgment to plaintiff Cooper Industries, LLC (Cooper), and the August 21, 2015 order denying their motion for reconsideration. The issues presented in this appeal are whether a Bill of Sale between plaintiff and its predecessor transferred insurance rights to plaintiff, and, if so, whether the transfer violated the anti-assignment clause contained in the insurance policies in question. We conclude that the sale transferred the insurance rights and did not violate the anti-assignment clauses. Thus, we affirm.

I.

To put the issues in perspective, a brief overview of plaintiff's corporate history is necessary. In 1928, Thomas A. Edison, Inc. began industrial operations in Kearny, New Jersey. In 1957, the company merged with McGraw Electric Company to form the McGraw-Edison Company (Old McGraw), and continued operations. Old McGraw later obtained primary and umbrella general liability insurance coverage from Commercial Union Insurance Company, a OneBeacon predecessor, covering Old McGraw from 1971 to 1980. In addition, American Employers Insurance, another OneBeacon predecessor, issued an umbrella policy covering 1974 to 1977, and Columbia issued two umbrella policies covering 1977 to 1978. The named insured on each policy was Old McGraw, and each policy contained an anti-assignment clause, barring any assignment of the policies without the insurers' consent. Additionally, the policies protected against occurrences, including environmental and pollution-related occurrences.

In May 1985, plaintiff acquired Old McGraw and set up ten "Mirror Image Companies" mimicking Old McGraw's previous business operations. The Mirror Image Companies owned an acquisition company called CI Acquisition, which, in turn, owned another acquisition company called CM Mergerco. Neither the Mirror Image Companies, CI Acquisition, nor CM Mergerco had any operating

assets. On May 31, 1985, CM Mergerco and Old McGraw merged with Old McGraw as the surviving entity. Thus, as of this date, CI Acquisition owned Old McGraw, with plaintiff as the owner of both through the corporate chain.

A year later, on May 30, 1986, Old McGraw and CI Acquisition merged, with CI Acquisition as the surviving entity. In this merger, the certification and agreement of merger documents revealed that CI Acquisition was assuming all of Old McGraw's liabilities and obligations, while absorbing all of Old McGraw's assets. The Merger Agreement transferred "all the property, rights . . . and other assets of ever [sic] kind and description" from Old McGraw to CI Acquisition. Despite the absence of any specific reference to insurance rights, appellants do not dispute that Old McGraw's insurance rights transferred to CI Acquisition through this merger.

Five minutes later on the same date, plaintiff merged five of the Mirror Image Companies together and renamed the surviving entity "McGraw-Edison Company" (New McGraw). CI Acquisition then distributed its assets, all of which had been Old McGraw's assets, to New McGraw and the remaining Mirror Image Companies.¹ This

¹ The remaining Mirror Image Companies were Cooper Clark, Cooper Power Systems, Cooper Service and Cooper Controls. Of the ten

distribution was effectuated by Bills of Sale issued to the five entities in exchange for their stock in CI Acquisition. In the Bill of Sale to New McGraw, with the exception of certain listed assets,² CI Acquisition transferred "all of [its] assets, rights and properties of every kind and nature . . . used in or related to all operations other than its Power Systems, Controls, Clark and Service operations." Although the Bill of Sale did not specify Old McGraw's insurance among the transferred assets, it stated that New McGraw assumed all of CI Acquisition's liabilities.

After distributing its assets, CI Acquisition liquidated itself. At that point, plaintiff owned the surviving Mirror Image Companies and New McGraw, which together owned all of Old McGraw's former assets. Eighteen years later, on November 30, 2004, plaintiff merged New McGraw into itself, with plaintiff as the surviving entity. Appellants do not dispute that if Old McGraw's insurance rights transferred to New McGraw through the 1986 Bill of Sale, then those rights transferred to plaintiff when it merged with New McGraw in 2004.

Mirror Image Companies originally created in 1985, one of them, Cooper Generators, was sold prior to the 1986 merger.

² The exempted assets consisted of those used in Old McGraw's business operations that had been transferred to the four corresponding Mirror Image Companies and were reflected in Bills of Sale issued to those companies.

In 2009, the Environmental Protection Agency (EPA) identified plaintiff as an entity responsible for the remediation of the Kearny site, based on Old McGraw's actions in generating and disposing hazardous substances there. The EPA considered plaintiff to be the "successor to a person who owned and operated the [s]ite[.]" In 2011, plaintiff notified appellants and Old McGraw's other liability insurers of the potential environmental claims. Plaintiff asserted that defense and indemnification were covered under the policies these insurers, including appellants, issued to Old McGraw. Appellants did not acknowledge any obligation to plaintiff related to the EPA action.

On April 19, 2013, plaintiff entered into an Administrative Settlement Agreement and Order on Consent with the EPA. In turn, on May 24, 2013, plaintiff filed a complaint against appellants and the other insurers, asserting breach of contract and seeking a declaratory judgment that it was entitled to coverage in the EPA action under Old McGraw's policies. On May 14, 2015, plaintiff moved for partial summary judgment on the issue of whether plaintiff could file claims under Old McGraw's policies. On June 12, 2015, following a hearing, the trial court granted plaintiff's motion.

In its decision, the court found that the language used in the 1986 Bill of Sale transferring all rights and assets from CI

Acquisition to New McGraw was ambiguous because it did not specifically reference insurance rights. To resolve this ambiguity and determine the intent of the parties in executing the 1986 Bill of Sale, the court relied on deposition testimony submitted by plaintiff in support of its motion from three of plaintiff's employees.

Diane Schumacher, who worked in plaintiff's law department and became general counsel to the company in 1995, was one of the three deponents. Although she did not participate in drafting the Bill of Sale, she had knowledge of plaintiff's business operations. Schumacher testified at two separate depositions, first as a fact witness and later as a corporate representative. She testified that the sale of CI Acquisition was intended to create New McGraw with all of the assets and liabilities of Old McGraw, including the insurance rights. She further testified that any assets that the four Mirror Image Companies received through the asset sale already belonged to those companies and did not include the insurance rights.

The other two deponents, Robert Teets and Anthony Black, worked in plaintiff's risk management and insurance department. Although neither was involved in the 1986 asset sale, they had personal knowledge of plaintiff's business operations both prior to and after the asset sale, as well as plaintiff's ongoing

business relationship with appellants. They testified that plaintiff made retroactive premium payments to defendants with plaintiff's logo on the checks. Furthermore, they asserted that plaintiff made claims against Old McGraw's insurance policies, which appellants paid. Documentary evidence corroborated the testimony of all three witnesses.

After considering the deposition testimony, the court determined that the 1986 Bill of Sale included the insurance rights under Old McGraw's policies, and that those rights transferred to plaintiff when it merged New McGraw into itself in 2004. Next, the court examined whether the transfer violated the anti-assignment clause contained in the insurance policies. The court acknowledged that plaintiff needed to prove that the 1986 transfer "constituted a valid post-loss assignment and/or that the transaction constitute[d] a de facto merger." To that end, the court found that the Kearny site had been polluted during the policies' coverage period in the 1970s and early 1980s, and, as such, Old McGraw's liability for that contamination attached before the 1986 asset sale. The court thus concluded that the anti-assignment clauses were inapplicable because the sale constituted a post-loss assignment of a claim to Old McGraw's successors, rather than a passing of the policies themselves. In the alternative, the court also found that the 1986 sale

constituted a de facto merger because "there was a continuity of management, ownership, personnel, and general business operations" between Old McGraw, CI Acquisition, New McGraw and then plaintiff.

On July 9, 2015, appellants moved for reconsideration. While the reconsideration motion was pending, the court conducted a bench trial on July 13, 2015 on all remaining issues. Although appellants did not participate in the bench trial, they informed the court that they had reached a settlement agreement with plaintiff. Thereafter, on July 23, 2015, the court entered a consent order memorializing the settlement agreement, wherein appellants agreed not to dispute the fact that plaintiff's claims for damages arose from occurrences that were covered by Old McGraw's policies. Appellants did however reserve the right to pursue their motion for reconsideration and to appeal from the June 12, 2015 decision or any adverse decision on the reconsideration motion. On August 21, 2015, the court issued an opinion and order, indicating it would not change its decision on reconsideration for the same reasons the court found previously. This appeal followed.

II.

We review a ruling on a motion for summary judgment de novo, applying the same standard governing the trial court. Templo Fuente De Vida Corp. v. National Union Fire Ins. Co., 224 N.J.

189, 199 (2016) (citation omitted). Thus, we consider, as the motion judge did, "whether the competent evidential materials presented, when viewed in the light most favorable to the non-moving party, are sufficient to permit a rational factfinder to resolve the alleged disputed issue in favor of the non-moving party." Brill v. Guardian Life Ins. Co. of Am., 142 N.J. 520, 540 (1995). If there is no genuine issue of material fact, we must then "decide whether the trial court correctly interpreted the law." DepoLink Court Reporting & Litig. Support Servs. v. Rochman, 430 N.J. Super. 325, 333 (App. Div. 2013) (citation omitted). We review issues of law de novo and accord no deference to the trial court's legal conclusions. Nicholas v. Mynster, 213 N.J. 463, 478 (2013). "[F]or mixed questions of law and fact, [we] give[] deference . . . to the supported factual findings of the trial court, but review[] de novo the lower court's application of any legal rules to such factual findings." State v. Pierre, 223 N.J. 560, 577 (2015) (citations omitted).

This standard compels the grant of summary judgment "if the pleadings, depositions, answers to interrogatories and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact challenged and that the moving party is entitled to a judgment or order as a matter of law." R. 4:46-2(c). "To defeat a motion for summary judgment,

the opponent must come forward with evidence that creates a genuine issue of material fact." Cortez v. Gindhart, 435 N.J. Super. 589, 605 (App. Div. 2014) (citation omitted). "[C]onclusory and self-serving assertions by one of the parties are insufficient to overcome the motion." Puder v. Buechel, 183 N.J. 428, 440-41 (2005) (citations omitted). Thus, if the evidence is "so one-sided that one party must prevail as a matter of law," the trial court's grant of summary judgment should be affirmed. Brill, 142 N.J. at 540. Applying the above standards, we discern no basis to reverse the grant of summary judgment.

Appellants contend the trial court erred in finding that the language of the 1986 Bill of Sale was ambiguous and then construing the Bill of Sale to include the transfer of the insurance rights. They assert the court improperly found that there was no genuine issue of material fact as to coverage. "When a trial court's decision turns on its construction of a contract, appellate review of that determination is de novo." Manahawkin Convalescent v. O'Neill, 217 N.J. 99, 115 (2014). No special deference is given to the trial court's interpretation, and we "look at the contract with fresh eyes." Kieffer v. Best Buy, 205 N.J. 213, 225 (2011).

An "unambiguous contract[] will be enforced as written unless [it is] illegal or otherwise violate[s] public policy." Leonard & Butler, P.C. v. Harris, 279 N.J. Super. 659, 671 (App. Div.

1995). If a contract's language is plain, that language alone must determine the agreement's effect. Manahawkin Convalescent, 217 N.J. at 118. However, if a contract is ambiguous, "courts will consider the parties' practical construction of the contract as evidence of their intention and as controlling weight in determining [the] contract's interpretation." County of Morris v. Fauver, 153 N.J. 80 (1998).

Extrinsic evidence is admissible to assist a court in "achiev[ing] the ultimate goal of discovering the intent of the parties," or "uncover[ing] the true meaning of contractual terms." Conway v. 287 Corporate Ctr. Assocs., 187 N.J. 259, 269-70 (2006). This evidence may include "the circumstances leading up to the formation of the contract, custom, usage, and the interpretation placed on the disputed provision by the parties' conduct." Kearny PBA Local #21 v. Town of Kearny, 81 N.J. 208 (1979). Ultimately, courts enforce contracts based on their express terms, their underlying purpose, the surrounding circumstances, and the intent of the parties. Manahawkin Convalescent, 217 N.J. at 118.

Here, in interpreting the 1986 Bill of Sale between CI Acquisition and New McGraw, the analysis boils down to whether the language alone clearly provided for the transfer of the insurance rights, and, if so, which entity received those rights. The Bill of Sale provided that CI Acquisition transferred "all of [its]

assets, rights and properties of every kind and nature" to New McGraw and the remaining Mirror Image Companies. Because insurance rights are unequivocally encompassed within the plain meaning of an asset or a right, the Bill of Sale undoubtedly transferred the insurance rights. This conclusion is further supported by appellants' concession that the merger agreement between Old McGraw and CI Acquisition transferred the insurance rights to CI Acquisition, despite failing to expressly reference those rights.

Nevertheless, this does not resolve the issue in its entirety. Rather, the remaining inquiry is whether the Bill of Sale effectively transferred the insurance rights to New McGraw or one of the Mirror Image Companies. In this regard, we agree that the language is ambiguous in that the Bill of Sale exempted certain assets and transferred those assets to the four Mirror Image Companies, but never specified which assets were being transferred to those companies and which were being transferred to New McGraw. Because it is impossible to discern from the plain meaning of the language whether the rights were part of "all operations" or were "relat[ed] to . . . Power Systems, Controls, Clark, [or] Services operations[,]" we agree with the trial court that the language was ambiguous and necessitated reliance on extrinsic evidence to aid in the interpretation of the Bill of Sale.

Based on the extrinsic evidence submitted by plaintiff, consisting of the deposition testimony of Teets, Black, and Schumacher, we are satisfied as was the trial court that plaintiff intended the insurance rights to pass from CI Acquisition to New McGraw. In particular, Schumacher's testimony made plaintiff's intentions in undergoing this corporate restructuring abundantly clear. Schumacher testified that, with the exception of the assets specifically owned by the four Mirror Image Companies, plaintiff's intent was to move all of Old McGraw's assets, including the insurance rights, to New McGraw. Schumacher explained that the insurance policies belonged to Old McGraw as the parent company and was intended to be included in the "all . . . other assets" language in the Bill of Sale to New McGraw.

In addition, Teets and Black both testified that after the Bill of Sale was effectuated, plaintiff continued to pay premiums on Old McGraw's insurance policies using checks with plaintiff's logo and appellants never refused those payments. Further, according to Teets and Black, plaintiff made claims under the policies and appellants paid out on the claims. The testimony was corroborated by documentary evidence and appellants submitted no evidence contradicting the proffered testimony. Thus, the evidence here was "so one-sided that one party must prevail as a

matter of law," Brill, 142 N.J. at 540, and the court's conclusion in this regard was amply supported by the record.

Appellants challenge the admissibility of the testimony that formed the basis for the court's decision, arguing that the deposition testimony was inadmissible hearsay because none of the three deponents participated in drafting the Bill of Sale and therefore had no personal knowledge of the drafter's intent. We evaluate a trial court's evidential ruling under an abuse of discretion standard. Knop v. Rosen, 425 N.J. Super. 391, 401 (App. Div. 2012). Such a ruling must be upheld "unless it can be shown that [it] . . . was so wide of the mark that a manifest denial of justice resulted." State v. Carter, 91 N.J. 86, 106 (1982).

Under N.J.R.E. 602, witnesses may not testify to a matter unless they have personal knowledge of it. One exception to that requirement is set forth in Rule 4:14-2, which provides that a party may depose a corporation, and the corporation must designate one or more persons to testify on its behalf. These corporate witnesses may then testify "as to matters known or reasonably available to the organization," even if these matters are outside the witness' personal knowledge. Ibid.

Under Rule 4:16-1(b), the deposition of a party or a witness designated as a corporate party's representative "may be used by

an adverse party for any purpose against the deponent or the corporation." Additionally, Rule 4:16-1(c) provides that any party may utilize the deposition of a witness, "whether or not a party," against any other party that was present or represented at the taking of the deposition "if the court finds that the appearance of the witness cannot be obtained." One of the listed reasons why a witness' deposition testimony may be submitted in lieu of live testimony is that the witness "is out of this state." Ibid.

Here, we acknowledge that Teets and Black were not involved with the drafting of the 1986 Bill of Sale. However, their testimony was confined to subjects about which they had personal knowledge, specifically, plaintiff's risk management, insurance, and ongoing business relationships with appellants as insurers. Therefore, their testimony regarding their retroactive premium payments to appellants, their submission of claims to appellants under Old McGraw's policies, and their receipt of payouts on claims from appellants was entirely proper. Furthermore, because Teets and Black lived in Texas and were indisputably "out of this state" at the time this matter was considered, admission of their deposition testimony was permissible under Rule 4:16-1(c).

Schumacher's testimony as both a fact witness and a corporate representative was also properly admitted under Rule 4:14-2. At

her first deposition, Schumacher testified about matters she had personal knowledge of, including plaintiff's operations before and after the Bill of Sale was effectuated and plaintiff's interactions with appellants. At her second deposition, her testimony concerned matters outside her personal knowledge, but within plaintiff's corporate knowledge. Additionally, it was also undisputed that Schumacher was in Mexico when the summary judgment motion was adjudicated and thus "out of this state." As a result, the use of her deposition testimony was permissible under Rule 4:16(c).

We reject appellants' additional argument that pursuant to Rule 4:16-1(b), the deposition of a corporate representative may only be used by an adverse party against the corporation. Appellants' reliance on federal case law and treatises applying F.R.C.P 30(b)(6), the federal equivalent to Rule 4:14-2, is misplaced, as those authorities address whether corporate designees deposed under the rule may be called to testify at trial to matters outside their personal knowledge, not whether their deposition testimony may be admitted into evidence. Moreover, in the cases relied upon by appellants, the corporate representative was available to testify, whereas here, appellants do not dispute that Schumacher was unavailable. Accordingly, we discern no abuse of discretion in the court's consideration of the deposition

testimony of Teets, Black, and Schumacher to aid in the interpretation of the Bill of Sale at issue.

Finally, appellants argue that even if the Bill of Sale included insurance rights under Old McGraw's policies among the transferred assets, the court should have found the transfer void based on the anti-assignment clauses contained in the policies. More specifically, appellants contend the court erred in finding that the Bill of Sale assigned claims under the policies because the Bill of Sale was drafted "decades before any assignable claim . . . could even exist."

It is undisputed that the subject policies required the insurers' consent in order to assign the policies to a third party. "However, once a loss occurs, an insured's claim under a policy may be assigned without the insured's consent." Givaudan Fragrances Corp. v. Aetna Cas. & Sur. Co., 442 N.J. Super. 28, 36 (2015). This is so because an assignment after a loss has occurred "is not an assignment of the policy, but of the claim for the insurance, and is not within the inhibition of [an anti-assignment] clause." Combs v. Shrewsbury Mut. Fire Ins. Co., 32 N.J. Eq. 512, 515 (N.J. Ch. 1880).

It is undisputed that appellants' policies were "occurrence" policies. In "occurrence" policies, the peril insured is the occurrence itself and, upon the happening of the occurrence,

"coverage attaches even though the claim may not be made for some time thereafter." Zuckerman v. Nat'l Union Fire Ins. Co., 100 N.J. 304, 310 (1985) (quoting S. Kroll, "The Professional Liability Policy 'Claims Made'" 13 Forum 842, 843 (1978)). In addition, once a covered loss occurs, the assignment from the insured to another party of the right to make a related claim "does not alter, in any meaningful way, the obligations of the insurer accepted under the policy," and instead changes only "the identity of the entity enforcing the insurer's obligation to insure the same risk." Elat, Inc. v. Aetna Cas. & Sur. Co., 280 N.J. Super. 62, 67 (App Div. 1995). The risk to the insurer is not thereby increased by changing the beneficiary of the insurance proceeds. Givaudan, 442 N.J. Super. at 37. In effect, the insurer becomes a debtor of the insured and cannot restrict the assignment of that debt through enforcement of an anti-assignment clause. Flint Frozen Foods v. Firemen's Ins. Co., 12 N.J. Super. 396, 401 (Law Div. 1951).

Here, in the July 23, 2015 consent order memorializing the settlement agreement, appellants agreed not to dispute that plaintiff's claims for damages arose from occurrences covered by the Old McGraw's policies. As a result, it is undisputed that any claims made under the policies related to the EPA action stemmed from occurrences during the policy periods. Because the insured-against occurrences happened before the 1986 asset sale, any

transfer from CI Acquisition to New McGraw of insurance rights under Old McGraw's policies was an assignment of claims, not the policies themselves. Thus, we agree with the trial court that the assignment of insurance rights in the 1986 Bill of Sale was a post-loss assignment, as opposed to an impermissible assignment of insurance policies.

Because of our disposition on the issues, we need not address the trial court's determination regarding a de facto merger.

Affirmed.

I hereby certify that the foregoing
is a true copy of the original on
file in my office.



CLERK OF THE APPELLATE DIVISION

4-4-3

AGREEMENT BETWEEN
THOMAS A. EDISON, INCORPORATED
and
McGRAW ELECTRIC COMPANY

AGREEMENT made between Thomas A. Edison, Incorporated, a New Jersey Corporation with its principal place of business at West Orange, New Jersey, hereinafter called "Edison" and McGraw Electric Company, a Delaware Corporation, with its principal place of business at Elgin, Illinois, hereinafter called "McGraw".

WHEREAS Edison is engaged in the business of owning and operating a manufacturing industry, producing and marketing a range of products, including dictating machines, batteries, instruments, medical gasses, juvenile furniture, and many others at West Orange and other locations, and throughout the United States and the world;

WHEREAS Edison desires to exchange the business, together with its related assets, for stock of McGraw; and

WHEREAS Edison's Board of Directors, subject to due approval of holders of more than two-thirds of its issued and outstanding voting stock, has duly authorized such exchange of Edison assets, in accordance with this agreement; and

WHEREAS at a duly convened meeting of the Board of Directors of McGraw, such acquisition of Edison's assets on the terms hereinafter set forth, was duly approved and authorized under the authority of McGraw's Certificate of Incorporation whereby McGraw is authorized to acquire and carry on this business in the manner herein specified.

IT IS THEREFORE AGREED:

1. Subject to the terms and conditions hereof, at the time of closing hereinafter referred to, Edison shall grant, convey, and assign to McGraw all its assets and properties of whatever kind and description, tangible and intangible, (including, without limitation, trade names, the company name, going concern value, and all instruments, documents, papers, books, and records of every kind except its minute book and stock record book), subject to the liabilities assumed by McGraw as set forth in paragraph 3. Such assets and properties shall include all Edison's assets as reflected on its balance sheet as of August 31, 1956 (Exhibit A hereto), subject to such changes and including such additions as have occurred and will occur in the ordinary course of its business between August 31, 1956 and the date of closing, except that Edison is authorized, prior to the closing date, to

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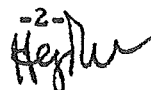
call its outstanding preferred stock remaining after the recapitalization referred to in paragraph 2 hereof. Notwithstanding the foregoing, Edison may retain from such properties and assets such amount of cash as is provided in paragraph 4 hereof.

2. Concurrently with the transfer to McGraw of Edison's assets as provided in paragraph 1 hereof, McGraw shall issue to Edison 252,242-1/2 shares of its fully paid non-assessable voting common stock with original issue taxes paid, plus an additional one-half share of such McGraw common stock for each share of Edison class B common stock issued after October 10, 1956 (1) pursuant to the exercise of stock options granted by Edison prior to October 10, 1956 and (2) in exchange for preferred stock of Edison in accordance with a plan of recapitalization whereby Edison has offered or will offer to exchange three shares of its class B common stock for each share of its preferred stock. It is agreed that in lieu of issuing the required shares herein to the acquired corporation, they shall be issued in accordance with the direction of Edison, in one certificate to J. P. Morgan & Co., Incorporated, of New York, New York, as nominee for Edison and as exchange agent for distribution to the Edison shareholders entitled thereto, in accordance with the plan of reorganization and to facilitate the carrying out of the terms of this agreement. Notwithstanding the foregoing, McGraw may withhold from the number of shares of its common stock which would otherwise be issued, the number of shares provided for in paragraph 4 hereof.

3. Concurrently with the transfer of its assets by Edison to McGraw as provided in paragraph 1 hereof and the issuance by McGraw to Edison of the McGraw common stock as provided in paragraph 2 hereof, McGraw shall assume and discharge and shall indemnify Edison against all debts, liabilities, and obligations of Edison as shown on Edison's balance sheet as of August 31, 1956 (Exhibit A hereto), and in addition shall assume and discharge and shall indemnify Edison against all debts, obligations, and liabilities, which have arisen at any time, or which will arise in the ordinary course of its business prior to the date of closing, except (1) Edison's liabilities, if any, to its shareholders as such, and (2) expenses incurred or to be incurred by Edison in effecting the plan of reorganization set forth herein and in effecting the winding up and dissolution of Edison as provided in paragraph 6.

4. Edison shall retain from the properties and assets referred to in paragraph 1 hereof such amount of cash as it may deem sufficient to cover (1) its expenses of reorganization and dissolution and (2) payment to the holders of Dissenting Shares (as defined hereinafter) and the expenses of Edison in connection therewith.

"Dissenting Share" or "Dissenting shares" as used in this Agreement means the share or shares of Class A or Class B Common Stock of

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Edison in respect of which the holders thereof have objected in writing to the transfer of assets of Edison provided for in paragraph 1 hereof and have demanded payment of the fair cash value thereof in accordance with the provisions of Section 14:3-5 of the General Corporation Laws of New Jersey and in respect of which at the time of closing such demand has not been effectively withdrawn.

Without the prior written approval of McGraw, Edison shall make no settlement or agreement with any shareholder as to the value of Dissenting Shares or permit a value of Dissenting Shares asserted by a shareholder to become final without adjudication thereof in proceedings conducted in good faith by Edison in consultation with McGraw.

McGraw shall withhold from the shares of Capital Stock which would otherwise be deliverable under paragraph 2 of this Agreement one-half (1/2) share of its Common Stock for each Dissenting Share of Edison Class A or Class B Common Stock. In the event that any holder of any Dissenting Shares should not become entitled to the payment of the value of his shares of Edison Common Stock pursuant to his demand therefor, then upon ascertainment of such fact, and if no payment has been made to such holder, McGraw shall deliver to Edison the additional shares of McGraw to which the holder of such shares of Edison shall be entitled unless such shares of McGraw shall have been previously delivered by McGraw to Edison.

Any cash remaining in Edison's hands after the payment of reorganization and dissolution expenses and payments to holders of Dissenting Shares shall be paid by Edison to McGraw.

5. McGraw shall take such steps as are necessary to increase its total authorized Common Shares from 3,000,000 shares of the par value of \$1 per share to 7,000,000 shares of the par value of \$1 and shall declare immediately after the closing date a stock dividend, payable not later than January 31, 1957, of one (1) share of its Common Stock for each share of its Common Stock then outstanding, it being the intention of the parties that each Common shareholder of Edison, other than holders of Dissenting Shares, shall receive upon dissolution of Edison as provided herein one (1) share of \$1 par value fully paid voting Common Stock of McGraw for each share of Class A or Class B Common Stock of Edison.

6. Edison agrees that as promptly as possible after the time of closing and after the receipt by it of the Common Stock of McGraw in exchange for its assets, as provided in paragraph 2 hereof, and including the shares received as a result of the stock dividend as provided in paragraph 5 hereof, to distribute all such Common Stock of McGraw among its shareholders other than holders of Dissenting Shares, in the proportion required by the Statutes of New Jersey and the Articles of Incorporation of Edison. Edison agrees that as promptly as practicable after the time of closing it

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will dissolve and wind up its affairs and will not engage directly or indirectly in any business whatsoever.

7. Edison agrees to change its name so that as of the date of closing its name shall no longer contain the word "Edison" or the words "Thomas A. Edison" or any words similar thereto. McGraw agrees prior to closing to change its name to "McGraw-Edison Company". Income and other tax returns and reports of Edison due until the date of dissolution shall be cleared with the Treasurer of McGraw, or his representative. McGraw shall have the benefit of, and shall perform all binding contracts and commitments made in the ordinary course of Edison's business which are outstanding on the date of closing, and shall indemnify Edison against liabilities under such contracts and commitments. This agreement will not be construed for the benefit of third parties. McGraw may decline assumption of any contract provided it saves Edison harmless from the consequences. Edison further agrees to provide McGraw with the written assurances of Charles Edison and Madeleine Edison Sloan that they have no present intention of marketing their McGraw shares publicly, and that their present intention is to hold such shares, when received, as an investment. X

8. Edison warrants and represents the following:

(a) Its financial reports submitted to McGraw and made a part hereof, namely, the audited P. and L. and balance sheet as of December 31, 1955, and the unaudited P. and L. and balance sheet of August 31, 1956, which has been signed by Edison's President fairly reflect the condition of the Corporation in accordance with sound accounting practices and, except for non-accrual of the past service pension liability, there are known to be no liabilities of any substantial consequence, not reflected in the said statements.

(b) There have been no changes in its financial condition since August 31, 1956, except those that have taken place in the ordinary course of business.

(c) Edison's Board has duly authorized the execution of this agreement; a copy of the minutes thereof shall be certified and filed with McGraw, and upon due approval by the shareholders, a rider to this document shall be supplied and countersigned by Edison's Secretary, duly evidencing Edison's shareholder actions.

(d) No finder's fees are involved in this transaction.

9. Edison represents the following:

(a) All tax returns required to be filed have been duly prepared and filed, and taxes shown thereon to be payable, have been duly paid. Edison's

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Federal Income and Excess Profits Tax Returns have been audited through December 31, 1954.

(b) There is no known or threatened litigation, action, proceeding, strike, lockout, or labor dispute, of any substantial consequence.

(c) Neither the corporation nor its officers and directors is a party to or the present subject of, or concerned in, any investigation, hearing or proceeding by or before any governmental agency, authority, or board.

(d) Edison has the following wholly-owned subsidiaries:

The following are New Jersey Corporations: Edison Wood Products, Incorporated, Measurements Corporation, Thomas A. Edison International Corporation, Pohatcong Railroad Company, Dictating Machine-Voice Writer Company.

Also: Thomas A. Edison, Limited, a British Corporation; Thomas A. Edison of Canada, Limited, a Canadian Corporation; Measurements Corporation of Canada, Limited, a Canadian Corporation which is a subsidiary of Thomas A. Edison of Canada, Limited.

10. Edison hereby covenants with McGraw that subject to exceptions mutually approved in writing, pending the closing:

(a) Its business will be conducted only in the ordinary course.

(b) No dividend, other than the regular dividend of 35¢ per share to holders of both classes of its Common Stock and \$1.62-1/2 to holders of its Preferred Stock (or such portion thereof as may be due upon the call of the Preferred Shares) to be paid in December, 1956, nor other distribution or payment will be declared or paid with respect to its capital stock, and it will not redeem, purchase, or otherwise acquire any such stock, except as allowed in paragraphs 1, 2, and 4.

(c) It will make no changes in any of its contracts or commitments, except as such changes occur in the ordinary course of business.

(d) It will make no new contracts or commitments for the purchase and sale of merchandise, materials, and supplies, except contracts in the ordinary course of business.

(e) It will make no unusual expenditures for any alterations, additions, or improvements, except as to commitments outstanding as of date of this agreement, to any of its property.

(f) It will make no salary changes or bonus arrangements of any kind other than in accordance with past consistent practices.

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(g) It will make available to McGraw for examination all its properties, books of account, minute books, deeds, title papers, insurance policies, contracts, tax returns, records, and documents of every character and shall permit McGraw and its agents, accountants, attorneys, and engineers to have access to the same at all reasonable times, and shall supply information requested by McGraw and its representatives.

11. McGraw represents the following:

(a) It is a corporation duly organized and existing under the laws of the State of Delaware, with outstanding capital stock as of this date consisting of 2,285,000 shares of Common Stock of \$1 par value per share, all of which shares are validly issued and non-assessable.

(b) Its Board of Directors has duly authorized the execution of this agreement.

(c) It is duly qualified to do business in the State of New Jersey.

(d) McGraw's balance sheet and P. and L. statement dated August 31, 1956, supplied to Edison, fairly reflects the assets, liabilities, and net worth of McGraw in accordance with its books kept pursuant to sound accounting practice, and in the aggregate there have been no adverse changes in its financial condition since August 31, 1956.

12. As conditions precedent to the closing of this transaction,

(a) Edison shall obtain the written opinion of Ivins, Phillips & Barker, its tax counsel, and a written ruling from the Internal Revenue Service to the effect that no gain or loss will be recognized for Federal Income Tax purposes as a result of (1) the exchange by Edison of its assets and properties for McGraw Common Stock and the assumption of the liabilities and obligations of Edison pursuant hereto, and (2) the exchange by the shareholders of Edison pursuant hereto of Class A and Class B Common Stock of Edison for shares of Common Stock of McGraw on the liquidation of Edison.

(b) In the interpretation of this agreements the requirements in paragraph 7 hereof that McGraw change its name to McGraw-Edison Company shall be considered a condition precedent.

(c) At the closing Edison will deliver an opinion of Paul J. Christiansen, its legal counsel: (1) That it has corporate existence and good standing; (2) that it has marketable title to the property and assets conveyed; (3) that, except as he advises otherwise, he does not know of any lawsuit, proceeding or investigation pending relating to the company, its properties or business; (4) that all proceedings required by law were taken

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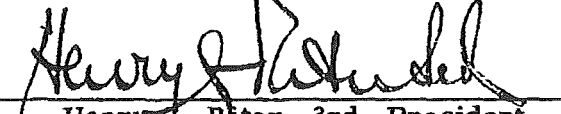
in support of the transaction; (5) that the instruments of conveyance tendered are sufficient to consummate the transaction.

13. The closing date shall take place at the office of Mr. Max McGraw, 120 South LaSalle Street, Chicago, Illinois, following due approval by the respective groups of shareholders as specified above, on January 2, 1957, unless this closing is deferred or anticipated by mutual written agreement. Upon the delivery to Edison of the required certificates for the McGraw Common Stock, Edison shall execute and deliver all deeds, bills of sale, conveyance, and such other instruments as are required by the agreement and as in the opinion of Clark J. A. Hazelwood, P. O. Box 2077, Milwaukee, 1, Wisconsin, are necessary to vest title in McGraw of all Edison's assets. All representations and covenants shall survive the closing.

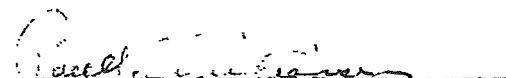
14. This agreement supersedes any and all previous agreements made during the course of negotiations between the parties. It shall inure to the benefit of and shall be binding upon the parties and upon their respective successors.

IN WITNESS WHEREOF the parties have signed this instrument.
Dated as of the 10th day of October, 1956.

THOMAS A. EDISON, INCORPORATED


Henry G. Riter, 3rd, President

Attest:


Paul J. Christiansen, Secretary

Approved:


Charles Edison, Chairman
Thomas A. Edison, Incorporated

McGRAW ELECTRIC COMPANY


Max McGraw, President

Attest:


Judson Large, Secretary

A - Acquisition Papers(F) - Thomas A. Edison Industries

- A-(F) - 1 Tentative Agreement for Merger dated 10-10-56.
 1(a) T. A. Edison Assignments
 2 Letter agreement dated 10-10-56 between M. McGraw and C. Edison.
 3 Signed final agreement for merger between Thomas A. Edison, Incorporated and McGraw Electric Company 10/10/56.
 4 Supplemental letter agreement dated 10/23/56.
 5 Supplemental letter agreement dated 10/26/56.
 6 Certified copy of resolutions adopted by Board of Directors of Thomas A. Edison, Inc. 10/29/56.
 7 Opinion letter from Ross & O'Keefe re resolutions adopted by Board of Thomas A. Edison, Inc. 10/10/56 and 10/29/56.
 8 Copy of opinion letter from Ivins, Phillips & Barleer dated 11/1/56 to Thomas A. Edison, Inc. re tax effect of merger.
 9 U.S. Treasury Department ruling on tax effect of merger 11/20/56.
 10 Letter of instruction to Transfer Agents re issuance of additional shares of McGraw for acquisition of Edison and 2 for 1 split 12/12/56.
 11 Certification of consent to merger by voting Stockholders of Thomas A. Edison, Inc. 12/14/56.
 12 Notice of Stockholders of Edison of special meeting to be held 12/20/56.
 13 Letter from Charles Edison re holding shares as Investment 12/20/56.
 14 Letter from Madeleine E. Sloane re holding shares as Investment 12/20/56.
 15 Certification of Edison Stockholders actions taken at special meeting of 12/20/56.
 16 Letter of direction to Transfer Agents and Registrars re issuance of stock in connection with Edison acquisition and 2 for 1 stock split 12/27/56.
 17 Letter from General Counsel of Edison re transactions being done in connection with dissolution of Edison 12/31/56.
 18 Letter from Clark J. Hazelwood 1/21/57.
 19 Closing documents - Acquisition of Daven Division of General Mills, Inc. January 2, 1964.
 20 Closing Documents - Acquisition of Sunbeam Electronics - May 26, 1969.

21. Letter to Lessor or Managing Agent of Premises Leased to Thomas A. Edison, Inc. dated January 2, 1857.
22. Bill of Sale from Thomas A. Edison, Incorporated, Grantor to McGraw-Edison Company, Grantee dated January 28, 1958.
23. Assumption of Liability of Thomas A. Edison, Incorporated by McGraw-Edison Company dated January 2, 1957.
24. Letter to Judson Large (VP and Secretary) of McGraw-Edison Company regarding Edison merger – Original closing documents dated January 29, 1957.

CERTIFICATE OF AMENDMENT
OF
MCGRAW ELECTRIC COMPANY

RECEIVED & FILED

19 2 1957

John H. McDowell
SECRETARY OF STATE

00157

2085-22

1-2-57

1/1/57

CERTIFICATE OF AMENDMENT
of
CERTIFICATE OF INCORPORATION

McGRAW ELECTRIC COMPANY, a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware, DOES HEREBY CERTIFY:

FIRST: That at a meeting of the Board of Directors of said Corporation duly held and convened, a resolution was duly adopted setting forth proposed amendments to the certificate of incorporation of said corporation and declaring said amendments advisable and calling a meeting of the stockholders of said corporation for consideration thereof.

"FURTHER RESOLVED, in implementation of such Agreement, and in implementation of the Directors' decision to eliminate the previously authorized 20,000 shares of \$100 par value per share Preferred Stock, that

- (a) This Board of Directors declares it advisable that the certificate of incorporation, as amended, of this Corporation be amended by changing the corporate title of this Corporation from 'McGraw Electric Company' to 'McGraw-Edison Company';
- (b) This Board of Directors declares it advisable that the number of authorized shares of Common Stock of this Corporation be increased from 3,000,000 to 7,000,000 shares by striking the first paragraph of Article IV of the certificate of incorporation, as amended, of this Corporation, except the caption 'Fourth' and substituting in lieu thereof the following:

"The total number of shares of all classes of stock which the Corporation shall have authority to issue is Seven Million (7,000,000) shares, all of which shall be Common Stock of the par value of One Dollar (\$1.00) each. "

SECOND: That thereafter, pursuant to resolution of its board of directors, a special meeting of the stockholders of said corporation was duly called and held, at which meeting the necessary number of stockholders as required by statute voted in favor of the amendments.

THIRD: That said amendments were duly adopted in accordance with the provisions of section 242 of The General Corporation Law of the State of Delaware.

FOURTH: That the capital of said corporation will not be reduced under or by reason of said amendments or either of them.

FIFTH: Neither of said amendments, as such, effects any change in the issued shares of the corporation.

IN WITNESS WHEREOF, said McGraw Electric Company has caused its corporate seal to be hereunto affixed and this certificate to be signed by R. G. Wheaton, its Vice President, and C. J. A. Hazelwood, its Assistant Secretary, this 21st day of December, 1955.

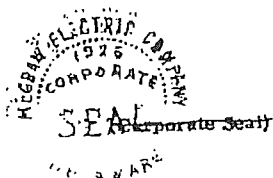
McGRAW ELECTRIC COMPANY

By

R. G. Wheaton
R. G. Wheaton, Vice President

By

C. J. A. Hazelwood
C. J. A. Hazelwood, Asst. Secretary



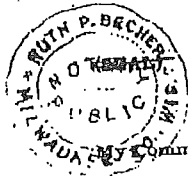
STATE OF WISCONSIN)
(ss:
COUNTY OF MILWAUKEE)

BE IT REMEMBERED that on this 21st day of December, A. D., 1955, personally came before me a Notary Public in and for the County and State aforesaid, R. G. Wheaton, Vice President of McGraw Electric Company, a corporation of the State of Delaware, the corporation described in and which executed the foregoing certificate, known to me personally to be such, and he, the said R. G. Wheaton as such Vice President, duly executed said certificate

before me and acknowledged the said certificate to be his act and deed and the act and deed of said corporation; that the signatures of the said Vice President and of the Assistant Secretary of said corporation to said foregoing certificate are in the handwriting of the said Vice President and Assistant Secretary of said corporation respectively, and that the seal affixed to said certificate is the common or corporate seal of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and seal of office the day and year aforesaid.

Ruth P. Becker
Notary Public, Milwaukee County
Wisconsin



Commission expires: April 27, 1958

A-4-23

ASSUMPTION OF LIABILITIES
of
THOMAS A. EDISON, INCORPORATED
by
McGRAW-EDISON COMPANY

KNOW ALL MEN BY THESE PRESENTS that McGRAW-EDISON COMPANY (formerly McGraw Electric Company), a Delaware corporation, in consideration of the conveyance to it by THOMAS A. EDISON, INCORPORATED (hereinafter called "Edison") of all its assets and properties as provided in that certain agreement between Edison and this company dated as of October 10, 1950, except certain cash reserved under Section 4 of said agreement, hereby assumes, and agrees to discharge and indemnify Edison against, all debts, liabilities and obligations of Edison, in accordance with, and to the extent provided in, Section 3 of said agreement, including, without limiting the generality of the foregoing, all of the obligations of Edison under those certain long-term loan agreements between Edison and The Prudential Insurance Company of America and The Mutual Benefit Life Insurance Company dated August 14, 1947 as amended and dated August 28, 1950, and the notes delivered pursuant thereto, including all the covenants contained in said agreements and notes, and agrees to discharge and indemnify Edison against all and any thereof.

Dated as of the opening of business on the 2nd day of January, 1957.

McGRAW-EDISON COMPANY

(Seal)

By MAX McGRAW, Jr.
President

Attest:

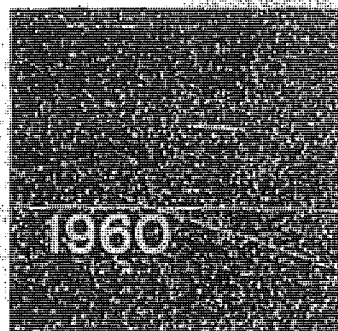
C. J. A. HAZELWOOD /s/
Asst. Secretary

The Electric Storage Battery Company Annual Report -- 1960
America's Corporate Foundation; 1960; ProQuest Historical Annual Reports
pg. 0_1

HF



72nd ANNUAL REPORT



THE ELECTRIC STORAGE BATTERY COMPANY

DIRECTORS

Schofield Andrews
 A. J. Cassatt
 Robert C. Corlett
 E. J. Dwyer
 Percy C. Madeira, Jr.
 Elmer B. Ott
 Donald W. Tyrrell
 Charles R. Tyson
 George D. Widener

OFFICERS

Elmer B. Ott, *Chairman of the Board*
 E. J. Dwyer, *President*
 J. S. Hudson, *Vice President—Employee Relations*
 J. A. McNay, *Vice President—Marketing*
 F. J. Port, *Vice President—Automotive Division*
 D. N. Smith, *Vice President—Finance*
 M. G. Smith, *Vice President—Industrial Division*
 William P. Cairo, *Secretary*
 C. J. Cresswell, *Comptroller*
 E. W. Williams, *Treasurer*

ASSISTANT OFFICERS and CORPORATE STAFF

G. C. Guild, *Assistant Secretary*
 H. J. Ulkoss, Jr., *Assistant Treasurer*
 K. W. Green, *Director of Purchases*
 R. A. Schaefer, *Director of Research*

Corporate Offices

2 Penn Center Plaza, Philadelphia 2, Pa

Transfer Agents

Fidelity-Philadelphia Trust Company, Philadelphia 9, Pa
 Morgan Guaranty Trust Company of New York, New York 15, N. Y.

Registrars.

The Philadelphia National Bank, Philadelphia 1, Pa.
 The First National City Bank of New York, New York 15, N. Y.

Annual Meeting

April 19, 1961

Proxy Material Mailed

March 11, 1961

■ Consolidated net sales totaled \$148,124,000, 2.5% above 1959 and the highest in the company's history.

■ Earnings after taxes were \$6,040,000, equal to \$3.58 per share, compared with \$6,108,000 or \$3.63 per share in 1959.

■ Dividends of \$3,369,763, equal to \$2.00 per share, were paid to stockholders. The company began its 61st year of uninterrupted quarterly dividends.

■ The company acquired the operating assets of the Edison Storage Battery Division of McGraw-Edison Company, and formed its new Nickel Alkaline Battery Division.

■ The new automotive battery plant at Logansport, Indiana, was put into operation.

■ Normal additions to fixed assets amounted to \$4,300,000, while \$3,600,000 was provided for depreciation. Completion of the Logansport plant and the Edison acquisition required additional capital expenditures of \$1,600,000.

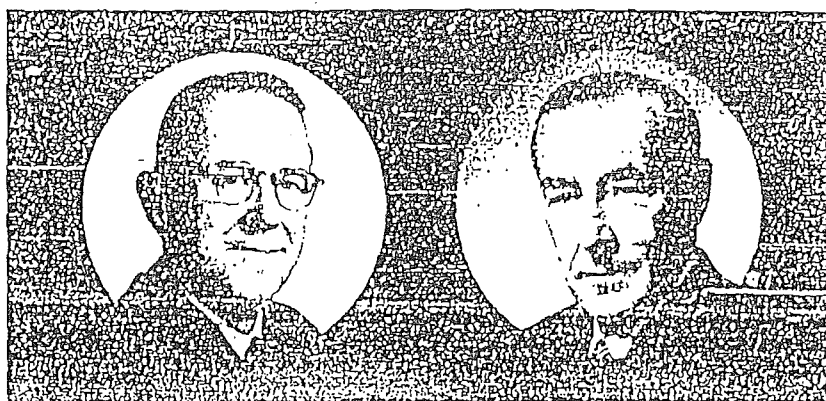
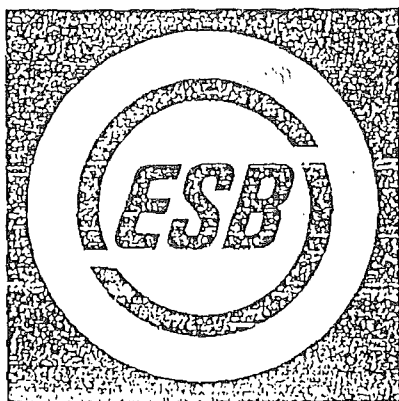
■ Operations in foreign markets were profitable, and additional manufacturing facilities were established in Panama, Australia, Mexico and Venezuela.

■ Stockholders' equity amounted to \$82,481,000, equal to \$48.93 per share.



THE POWER-PACKED WORLD OF ESB

Supplementing this Annual Report is the booklet "The Power-Packed World of ESB," graphically presenting your company, its structure, its research and its products.



E. J. Dwyer, President

Elmer B. Ott, Chairman of the Board

To Our Stockholders:

Your company had a good year in 1960 when considered against the background of a general business economy that did not measure up to early expectations. Earnings were maintained at levels close to those of 1959. Manufacturing facilities were expanded and improved and new products were developed for future growth.

Consolidated net sales totaled \$118,121,000, a new high for the company, and an increase of 2.5 per cent as compared with the 1959 sales of \$114,578,000. Consolidated income before taxes was \$11,416,000, compared with \$12,361,000 in 1959. After provision for income taxes, consolidated net income for 1960 was \$6,040,000, equal to \$3.58 per share on 1,685,764 shares outstanding on December 31, 1960. The 1959 net income amounted to \$6,108,000, equal to \$3.63 per share on the 1,680,964 shares then outstanding. The decline in pre-tax income was due largely to non-recurring costs incident to transfer of automotive battery manufacturing to Logansport, Indiana, upon the closing of the Cleveland plant. The relatively smaller decline in net income was due principally to the favorable effect on income taxes of property disposals at Cleveland during 1960.

CAPITAL EXPENDITURES

Expenditures for property, plant and equipment in 1960, totaled approximately \$8,900,000. Of this amount \$4,600,000 was spent on two major projects, the purchase of the manufacturing facilities of the Edison Storage Battery Division of McGraw-Edison Company and for the completion of the new automotive plant at Logansport, Indiana. The remainder, or \$4,300,000, was expended for normal additions and improvements and the building of several new manufacturing plants in foreign countries. Depreciation for the year amounted to approximately \$3,600,000. During the year your company disposed of surplus and obsolete manufacturing facilities having a depreciated value of \$1,300,000. These were principally in connection with the closing of the Cleveland plant. Additional surplus facilities, having a book value of approximately \$650,000, are on the market for sale.

Capital expenditures planned for 1961 total approximately \$4,000,000, with an expected depreciation expense of \$3,800,000.

FINANCIAL POSITION

Net working capital at the end of 1960 amounted to \$16,983,000, and

the ratio of current assets to current liabilities was 3.4 to 1. This compared with working capital of \$48,948,000, and a current ratio of 4.2 to 1 at the end of 1959.

To provide the cash needed to purchase the assets and business of the Edison Storage Battery Division and to support the higher volume of sales, the company continued its policy of short-term bank borrowing and, for the first time, sold its short-term notes in the open market. This commercial paper was readily marketed at the best rates available for short-term public issues of industrial notes.

Stockholders' equity at December 31, 1960, totaled \$82,481,000, or \$18.93 per share. This compares with \$79,678,000, or \$17.40 per share at the end of 1959.

OPERATIONS

Sales of the Ray-O-Vac Company Division were maintained at levels close to those of the previous year and earnings increased, despite intense competitive pressures. Progress was made in the development, manufacture and marketing of standard Ray-O-Vac products, and development continued on mercury batteries to meet the demands of the expanding electronics field.

The Industrial Division's sales and earnings were higher. Its backlog includes a \$5,275,000 contract for submarine batteries received late in 1960.

The Edison Storage Battery Division, whose operating assets were acquired late in 1960, was renamed the Nickel Alkaline Battery Division. Substantial progress has been made in the integration of this business into the Industrial Division. Long-range plans have been made for its future operation and the further development of its products as important additions to your company's coverage of the packaged power field.

Automotive replacement sales followed the decline of about 1 per cent experienced by the industry in 1960. Because of our growth in other fields, rises and declines in the automotive original equipment market no longer have the significant effect on our over-all operations that they once had; sales in this market now account for less than 10 per cent of the company's total sales. The Automotive Division is marketing new battery types for American and foreign compact cars and has introduced a line of products which opens up an interesting new market for packaged alternating current.

The Missile Battery Division has completed its consolidation of all company activities in the missile battery field in its combined facilities at Raleigh. Its products are successful in the Polaris program, the torpædo battery market, and other missile applications. The division has developed a sealed silver-zinc battery for use in special military applications.

Development and marketing of microporous plastics in textile and non-textile applications is making progress. ESB-Reeves Corporation, which we own jointly with Reeves Brothers, Inc., is handling the non-textile aspects of this business, and is developing new uses for these materials. Reeves Brothers is moving aggressively in the textile field. Waterproof, breathable garments of microporous plastic coated fabrics are available in retail stores.

We are continuing our interest in battery-powered street trucks because we feel the sound design and development of this type of vehicle has a real potential for our storage battery business. During 1960, the company acquired a 51 per cent interest in the Cleveland Electric Vehicle Company, and we are now in limited production in new facilities at Chardon, Ohio.

FOREIGN ACTIVITIES

Our Canadian subsidiaries felt the effects of the general recession in Canada in diminished volume and profits. Operations in other foreign markets were profitable and encouraging for the future. Automotive battery manufacture commenced in new facilities in Panama and Australia, and a new industrial battery plant went into production in Mexico. Storage battery production will begin in Argentina in 1961. New dry battery plants were constructed in Thailand and Venezuela, and the Mexican plant was moved from leased premises into a company-owned property. Pending clarification of the legal status of our small operation in Cuba, management has made appropriate adjustments with respect to that investment.

RESEARCH

Basic and applied research at the Carl F. Norberg Research Center yielded encouraging results. Work continued on further improvements of lead acid batteries and other standard products. Several projects nearing completion should improve and expand our line of nickel alkaline batteries. Fuel cell research was intensified, and your company's high-rate oxygen electrode is now being used in an important military fuel cell project. Progress was made in research and development of an electrochemical process for removing salt from sea water under a Government contract.

Following the death of Clifton G. Gimes, Vice President — Research,

Dr. R. A. Schaefer, a well known industrial scientist, was appointed Director of Research.

PERSONNEL

We wish to express genuine appreciation for the loyal efforts of our more than 8,000 employees, who again contributed substantially to your company's progress in the last year. To a considerable degree the profitable character of our business and our success in maintaining and expanding our markets are the result of their initiative and cooperation and our aggressive training programs. We will continue to emphasize these programs.

OUTLOOK

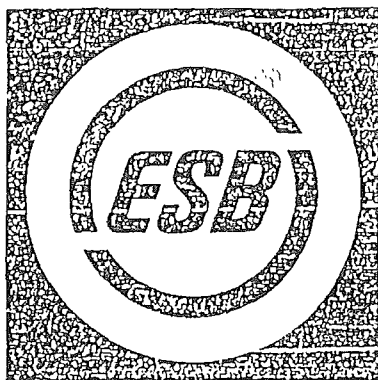
The lower level of business that marked the closing months of 1960 may continue for some time before a well defined upturn in the general economy is evident. In spite of any adverse effect this might have on your company's operations, we see a number of bright spots that promise good results for the year as a whole. Among these are new products and improvements in established products which we may expect from our research and development programs. Our plant modernization program, recent acquisitions, and additions to our domestic and foreign facilities also should have a favorable effect on our 1961 operations.

Respectfully submitted by order
of the Board of Directors

Elmer B. Ott
Chairman of the Board

E. J. Meyer
President

March 7, 1961



CONSOLIDATED BALANCE SHEETS

December 31, 1960 and 1959

ASSETS	1960	1959
Current assets		
Cash in banks and on hand	\$ 2,839,174	\$ 4,476,690
Marketable securities, at cost (quoted market value: 1960, \$1,348,127; 1959, \$1,509,234)	1,340,940	1,497,800
Receivables, less reserve	25,752,089	25,203,135
Inventories, at lower of cost or market:		
Products finished and in process	24,343,398	20,939,678
Raw materials and supplies	11,482,123	11,085,756
	<u>35,825,521</u>	<u>32,025,434</u>
Other current assets	<u>1,003,080</u>	<u>809,289</u>
Total current assets	<u>\$66,761,704</u>	<u>\$64,012,348</u>
Investments		
Affiliated companies and foreign branch, substantially at cost	1,433,001	537,824
Mortgages resulting from sales of excess property	382,874	645,179
Fixed assets, at cost:		
Land	1,553,109	1,458,323
Buildings, machinery and equipment	73,049,383	70,191,002
	<u>74,602,492</u>	<u>71,649,325</u>
Less accumulated depreciation	<u>38,711,304</u>	<u>39,768,825</u>
	<u>35,891,188</u>	<u>31,880,500</u>
Other assets, principally unabsorbed deposits with mutual insurance companies	<u>541,907</u>	<u>708,631</u>
	<u>\$105,010,674</u>	<u>\$97,784,482</u>

THE ELECTRIC
STORAGE BATTERY
COMPANY AND
CONSOLIDATED
SUBSIDIARIES

LIABILITIES

	1960	1959
Current liabilities:		
Notes payable and current maturities of long-term debt	\$ 7,806,211	\$ 1,569,361
Accounts payable, vendors and others	5,521,152	5,810,245
Provision for Federal, state and foreign income taxes, net in 1959 of \$173,212 tax notes	3,527,025	4,467,901
Taxes other than income taxes	589,936	503,524
Salaries and wages	1,562,013	1,502,151
Other accrued liabilities	772,268	1,211,328
Total current liabilities	\$19,770,605	\$15,064,510

Long-term debt (less current maturities).

Notes payable, 3½%, due in annual installments of \$250,000 to \$275,000 to April 1, 1969; \$525,000 on April 1, 1970	2,625,000	2,875,000
Mortgage loans on plants of subsidiary companies, payable in equal installments to 1975	126,289	166,861

STOCKHOLDERS' EQUITY

Common stock, \$10 par shares authorized, 2,500,000; issued, 1,712,145	17,121,450	17,121,450
Capital in excess of par value of common stock	10,757,207	10,787,961
Retained earnings	55,501,035	52,831,162
	83,379,692	80,740,573
Less common stock in treasury, at cost:		
1960, 26,381 shares, 1959, 31,181 shares	898,912	1,062,462
Total stockholders' equity	82,480,780	79,678,111
	\$105,010,674	\$97,781,482

See appended notes on page 7



THE ELECTRIC STORAGE BATTERY COMPANY and Consolidated Subsidiaries

CONSOLIDATED STATEMENT OF INCOME Years Ended December 31, 1960 and 1959

	1960	1959 (Reclassified)
Net sales	\$148,123,960	\$144,578,156
Cost of sales	113,193,476	110,359,345
Selling, administrative and general expenses	22,007,711	20,605,146
Provision for pensions	1,900,000	1,860,721
Interest expense	481,613	361,409
Other (income) and expenses, net	(905,001)	(969,162)
	<u>136,677,799</u>	<u>132,217,459</u>
Income before income taxes	11,446,161	12,360,697
Provision for Federal, state and foreign income taxes	5,406,525	6,253,190
Net income	<u>\$ 6,039,636</u>	<u>\$ 6,107,507</u>

Net income is after deducting provision for depreciation of \$3,635,954 in 1960 and \$3,261,221 in 1959.

CONSOLIDATED STATEMENT OF RETAINED EARNINGS

	1960
Balance at beginning of year	\$52,831,162
Net income for the year	6,039,636
	<u>58,870,798</u>
Cash dividends paid, \$2.00 per share	3,369,763
Balance at end of year	<u>\$55,501,035</u>

CONSOLIDATED STATEMENT OF CAPITAL
in Excess of Par Value of Common Stock

	1960
Balance at beginning of year	\$10,787,961
Charge arising from sale of treasury stock pursuant to stock option agreements	30,754
Balance at end of year	<u>\$10,757,207</u>

See appended notes on page 7

Notes to CONSOLIDATED FINANCIAL STATEMENTS

(1) Principles of Consolidation

The consolidated financial statements include those of the parent and all wholly owned subsidiaries. They include foreign net assets, stated in United States currency, of \$13,941,649 of which \$7,401,987 were net current assets. Consolidated net income includes earnings of foreign subsidiaries in the amount of \$1,584,174.

(2) Pensions

Income for 1960 has been charged with a provision of \$1,900,000 for pensions under various plans. Of that amount \$1,512,261 was contributed to irrevocable trust funds, \$139,111 was paid for the purchase of group annuities and \$218,625 was paid direct to retired employees as supplemental pension benefits.

The contributions to the trust funds and the payment of group annuity premiums covered the current service cost and a portion of past service cost of the employees under the plans.

(3) Restrictions on Retained Earnings

The loan agreement relating to the 3½ per cent notes payable contains various restrictions relative to the payment of cash dividends and reacquisitions of capital stock. At December 31, 1960, approximately \$15,500,000 was available for such payments.

(4) Contingent Liabilities

It is the company's practice to sell to a bank certain receivables arising from the sale or lease sale of its products. The December 31, 1960 balances of these receivables aggregated \$1,908,000. The arrangement with the bank requires that the company repurchase any receivable on which payments become more than 90 days past due. No substantial amounts have been repurchased by the company.

(5) Stock Options

Options have been granted to certain officers and key employees during 1956,

1957 and 1960. A summary of common stock under option at the beginning and end of the year and the changes thereon is as follows:

	No. of Shares
Under option, January 1, 1960	15,660
Options granted during 1960	7,500
	<u>23,160</u>
Options exercised for an aggregate option price of \$132,797	4,800
Options canceled	None
	<u>1,000</u>
Under option, December 31, 1960	18,360

The shares under option at December 31, 1960 are at an average price of \$12.33 per share for an aggregate amount of \$777,270. Unoptioned shares under the stock option plan were 59,850 at December 31, 1960.

ACCOUNTANTS' REPORT

To the Board of Directors,
The Electric Storage Battery Company,
Philadelphia

We have examined the consolidated balance sheet of The Electric Storage Battery Company and its consolidated subsidiaries as of December 31, 1960 and the related consolidated statements of income, retained earnings and capital in excess of par value of common stock for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, however, it was not practicable to obtain confirmation of amounts due from departments and agencies of the United States Government, as to which we have satisfied ourselves by means of other auditing procedures.

In our opinion, the accompanying statements present fairly the consolidated financial position of The Electric Storage Battery Company and its consolidated subsidiaries as of December 31, 1960 and the consolidated results of their operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

LYBRAND, ROSS BROS. & MONTGOMERY
Certified Public Accountants

Philadelphia, Pa.
February 15, 1961



THE ELECTRIC STORAGE BATTERY COMPANY and Consolidated Subsidiaries

FIVE YEAR STATISTICAL REVIEW

Dollar amounts in thousands except per share figures.

OPERATING RESULTS

	1960	1959	1958	1957(a)	1956(a)
Net sales	\$148,121	\$144,578	\$127,573	\$140,318(b)	\$133,632(b)
Cost of sales, selling, administrative and general expenses	131,565	127,703(c)	115,481(c)	124,556(b)(c)	119,105(b)(c)
Depreciation expense	3,636	3,261	3,101	2,992	2,740
Provision for pensions	1,900	1,861(c)	1,790(c)	1,354(c)	1,141(c)
Other income or (expenses), net(d)	423	608	395	383	303
Income before income taxes	11,446	12,361	7,593	11,799	10,949
Income taxes	5,406	6,253	3,637	6,093	5,572
Net income	6,040	6,108	3,956	5,706	5,377
Per share—Outstanding at year-end	\$3.58	\$3.63	\$2.38	\$3.44	\$3.23
Dividends paid in cash	3,370	3,339	3,319	3,151	2,678
Earnings retained in the business	2,670	2,769	637	2,555	2,699
Gross expenditures for property, plant and equipment	8,941	3,065	4,100	3,827	2,723

FINANCIAL POSITION
AT YEAR-END

Current assets	\$66,762	\$61,012	\$56,169	\$55,141	\$55,943
Current liabilities	19,779	15,064	10,481	9,136	12,412
Net working capital	46,983	45,948	45,688	46,005	43,531
Per share—Outstanding at year-end	\$27.87	\$29.12	\$27.48	\$27.74	\$26.13
Ratio of current assets to current liabilities	3.4	4.2	5.4	6.0	4.5
Net property, plant and equipment	\$35,091	\$31,881	\$32,587	\$31,903	\$31,154
Long-term debt	2,751	3,012	3,238	3,521	3,753
Stockholders' equity	82,481	79,678	76,194	75,113	72,928
Per share—Outstanding at year-end	\$48.93	\$47.40	\$45.83	\$45.29	\$43.77

OTHER DATA

Shares outstanding at year-end	1,685,761	1,680,964	1,662,352	1,658,472	1,666,074
Annual dividend rate (ESB only)	\$2.00	\$2.00	\$2.00	\$2.00	\$2.00
Number of stockholders	15,543	16,680	17,876	17,237	17,199
Number of employees	8,121	8,017	7,922	8,261	8,343

(a) Ray-O-Vac was acquired in November 1957. The 1957 and 1956 figures give effect retroactively to this acquisition.

(b) Adjusted to apply Ray-O-Vac Division freight on sales as a reduction of consolidated sales to conform with company practice.

(c) Provision for pensions adjusted to include supplementary payments.

(d) Includes interest.

DIVISIONS

Automotive Division, Cleveland, Ohio
 Industrial Division, Philadelphia, Pennsylvania
 Missile Battery Division, Raleigh, North Carolina
 Nickel Alkaline Battery Division, West Orange, New Jersey
 Ray-O-Vac Company Division, Madison, Wisconsin
 Stokes Molded Products Division, Trenton, New Jersey
 Willcon Products Division, Reading, Pennsylvania

PRINCIPAL SUBSIDIARIES

■ In the United States

The Atlas Mineral Products Company of Pennsylvania, Mertztown, Pennsylvania
 ESB International Corp., New York, New York
 Mayfair Molded Products Corporation, Schiller Park, Illinois

■ In Foreign Countries

Companhia Brasileira de Baterias ESBIC
 The Electric Storage Battery Company (Canada) Limited
 ESBIC Corporation, S. A.
 Ray-O-Vac (Canada) Ltd.
 Ray-O-Vac de Mexico, S. A.
 Ray-O-Vac International Corporation of Panama
 Willard South Africa Limited
 Willard Australia Pty. Ltd.

MANUFACTURING AND ASSEMBLY PLANTS

■ Industrial Batteries

Bloomfield, New Jersey
 Buenos Aires, Argentina
 Chicago, Illinois
 Monterrey, Nuevo Leon, Mexico
 Monza (Milan), Italy
 Philadelphia, Pennsylvania
 San Francisco, California
 Scarborough, Ontario, Canada
 West Orange, New Jersey

■ Automotive Batteries and Accessories

Allentown, Pennsylvania
 Atlanta, Georgia
 Aurora, Illinois
 Barranquilla, Colombia
 Buenos Aires, Argentina
 Calgary, Alberta, Canada
 Clinton, Massachusetts
 Dallas, Texas
 Denver, Colorado
 Fairfield, Connecticut
 Guacara (Caracas), Venezuela
 Havana, Cuba
 Kansas City, Missouri
 Kogarah, New South Wales, Australia
 Logansport, Indiana
 Los Angeles, California
 Memphis, Tennessee
 Minneapolis, Minnesota
 Monza (Milan), Italy
 Omaha, Nebraska
 Panama, Republic of Panama
 Port Elizabeth, Union of South Africa
 Salisbury, Federation of Southern Rhodesia and Nyasaland
 Toronto, Ontario, Canada
 Warsaw, Illinois

■ Missile Batteries

Raleigh, North Carolina

■ Specialty Batteries

Racine, Wisconsin

■ Dry Cell Batteries and Flashlights

Bangkok, Thailand
 Clinton, Massachusetts
 Guacara (Caracas), Venezuela
 Lancaster, Ohio
 Madison, Wisconsin
 St. James (Winnipeg), Manitoba, Canada
 San Bartolo, Naucalpan, Mexico
 Williamsport, Pennsylvania
 Wonevot, Wisconsin

■ Molded and Extruded Plastics

Kensington, Connecticut
 Schiller Park, Illinois
 Trenton, New Jersey

■ Corrosion Proof Coatings, Linings and Cements

Mertztown, Pennsylvania

■ Safety Equipment and Sunglasses

Reading, Pennsylvania

■ Electric Street Trucks

Chardon, Ohio

[CONFORMED COPY]

AGREEMENT AND PLAN OF MERGER

AGREEMENT AND PLAN OF MERGER, dated March 29, 1985, by and among Cooper Industries, Inc., an Ohio corporation ("Parent"), CI Acquisition Company, a Delaware corporation and a wholly owned subsidiary of Parent ("Offer Sub"), and McGraw-Edison Company, a Delaware corporation (the "Company") (Offer Sub and the Company being sometimes hereinafter together referred to as the "Constituent Corporations", provided, however, that if in lieu of Offer Sub, Parent shall, pursuant to Section 2.01(a), elect to cause another direct or indirect subsidiary to be merged into the Company, such other subsidiary and the Company shall be the "Constituent Corporations" for purposes of this Agreement).

WHEREAS, Offer Sub has commenced a tender offer for any and all shares of common stock, par value \$1.00 per share (the "Shares"), of the Company at a price of \$65 per Share, net to the seller in cash, upon the terms and subject to the conditions set forth in Offer Sub's Offer to Purchase dated March 27, 1985 (the "Offer to Purchase") and the related Letter of Transmittal (which together constitute the "Offer"); and

WHEREAS, the Board of Directors of Parent and the Company have each determined that it is advisable to merge Offer Sub or another direct or indirect subsidiary of Parent with and into the Company pursuant to this Agreement with the result that the Company shall become a wholly-owned direct or indirect subsidiary of Parent;

NOW, THEREFORE, in consideration of the premises and the mutual covenants herein contained, Parent, Offer Sub and the Company hereby agree as follows:

ARTICLE ITHE OFFER

1.01 Company Action. (a) The Company hereby consents to the Offer and represents that the Company's Board of Directors has approved the Offer and the Merger (as such term is defined in Section 2.01(a) of this Agreement), has resolved to recommend acceptance of the Offer and adoption of this Agreement by the Company's stockholders and has determined that the Offer and Merger are fair and in the best interests of the Company's stockholders. The Company shall promptly

file with the Securities and Exchange Commission (the "Commission") and mail to the holders of Shares a Solicitation/Recommendation Statement on Schedule 14D-9 with respect to the Offer (the "Schedule 14D-9"), which shall, subject to the fiduciary responsibilities and obligations of the Board of Directors under applicable law, in the opinion of counsel, reflect such recommendation.

(b) The Company shall promptly furnish Parent with a list of the holders of Shares and mailing labels containing the names and addresses of all record holders of Shares and lists of securities positions of Shares held in stock depositories, each as of a recent date, and shall promptly furnish Parent with such additional information, including updated lists of stockholders of the Company, mailing labels and lists of securities positions, and assistance as Parent or its agents may reasonably request in connection with the Offer.

(c) Offer Sub shall not decrease the price per Share to be paid pursuant to the Offer.

(d) Offer Sub shall promptly amend the Offer to amend the conditions set forth in paragraphs (a), (b), (d) and (f) of Section 16 of the Offer to Purchase to read as set forth in Schedule A hereto and to add the conditions set forth in paragraphs (g), (h) and (i) set forth in such Schedule. Except as expressly modified in accordance with this Section 1.01(d), all of Section 16 of the Offer to Purchase shall remain in full force and effect and shall not be changed in any respect as a result of this Agreement.

1.02 Directors. Promptly upon the acceptance for payment of any Shares pursuant to the Offer, and from time to time thereafter as Shares are accepted for payment or otherwise purchased, Offer Sub shall be entitled to designate such number of directors, rounded up to the next whole number, on the Company's Board of Directors as will give Offer Sub representation on the Board of Directors equal to that number of directors (but not more than a majority of the directors) which equals the product of the total number of directors on the Board of Directors (giving effect to any directors elected pursuant to this sentence) multiplied by the percentage that such number of Shares so accepted for payment or purchased bears to the number of Shares outstanding, and the Company shall, at the request of Offer Sub, use its best efforts to increase the size of the Board and/or obtain the resignation of that number of directors sufficient to create the vacancies for the number of directors which Offer Sub is entitled

to designate under this Section 1.02 and with respect to each vacancy created by such increase in size or resignations shall take all lawful action necessary to effect the election of Offer Sub's designees to the Board, including mailing to its stockholders the information required by Section 14(f) of the Securities Exchange Act of 1934, as amended (the "Exchange Act") and Rule 14f-1 promulgated thereunder. No action will be taken by the Board of Directors of the Company after election or appointment of Parent's designees to the Company's Board of Directors with respect to the amendment or termination of this Agreement or the waiver of any right of the Company hereunder without the concurrence of a majority of the directors not so designated by Parent.

ARTICLE II

THE MERGER

2.01 The Merger. (a) Subject to the terms and conditions hereof, at the Effective Time (as such term is defined in paragraph (b) of this Section 2.01), Offer Sub or, in Parent's sole discretion, another direct or indirect subsidiary of Parent shall be merged with and into the Company (the "Merger") in accordance with the provisions of the General Corporation Law of the State of Delaware (the "GCL"), the separate existence of Offer Sub (or of such other subsidiary) shall cease and the Company shall continue as the surviving corporation in the Merger (the "Surviving Corporation") under the name "McGraw-Edison Company".

(b) As soon as practicable after satisfaction or waiver of the conditions set forth in Article V of this Agreement, the parties hereto shall cause the Merger to be consummated by the filing of an appropriate certificate of merger (the "Certificate of Merger") with the Secretary of State of the State of Delaware in accordance with the provisions of Section 251 of the GCL or, if applicable, a certificate of ownership and merger pursuant to Section 253 of the GCL. The date and time when the Merger shall become effective shall be the time of filing and is referred to herein as the "Effective Time".

(c) At the Effective Time, the Surviving Corporation shall thereupon and thereafter possess all the rights, privileges, powers and franchises, as well of a public as of a private nature, of each of the Constituent Corporations,

and be subject to all the restrictions, disabilities and duties of each of the Constituent Corporations; and all and singular, the rights, privileges, powers and franchises of each of the Constituent Corporations, and all property, real, personal and mixed, and all debts due to either of the Constituent Corporations on whatever account, as well for stock subscriptions as all other things in action or belonging to each of the Constituent Corporations shall be vested in the Surviving Corporation; and all property, rights, privileges, powers and franchises and all and every other interest shall be thereafter as effectually the property of the Surviving Corporation as they were of the several and respective Constituent Corporations; and the title to any real estate, vested by deed or otherwise, under the laws of the State of Delaware or elsewhere in either of the Constituent Corporations, shall not revert or be in any way impaired by reason of the Merger; but all rights of creditors and all liens upon any property of either of the Constituent Corporations shall be preserved unimpaired, and all debts, liabilities and duties of each of the Constituent Corporations shall thenceforth attach to the Surviving Corporation, and may be enforced against it to the same extent as if said debts, liabilities and duties had been incurred or contracted by it; all in accordance with Section 259(a) of the GCL.

2.02 Closing. The closing of the Merger shall take place at the offices of Vinson & Elkins, First City Tower, Houston, Texas 77002, at 12:00 Noon, local time, on the day on which the last of the conditions set forth in Article V of this Agreement is fulfilled or waived.

2.03 Conversion of Shares. Subject to the terms and conditions of this Agreement, at the Effective Time, by virtue of the Merger and without any action on the part of the holder of any securities of the Constituent Corporations:

(a) each Share then issued and outstanding, other than Dissenting Shares (as such term is defined in Section 2.05 of this Agreement) and Shares to be cancelled pursuant to paragraph (b) of this Section 2.03, shall be converted into and represent the right to receive \$65 net in cash or any higher price per Share which may be paid pursuant to the Offer, without any interest thereon (the "Merger Consideration");

(b) each Share then held, directly or indirectly, by Parent, Offer Sub or any subsidiary or parent of Parent or Offer Sub, or held in the Company's treasury, shall be cancelled and retired without payment of any consideration therefor; and

(c) each share of common stock of Offer Sub (or of the direct or indirect subsidiary of Parent other than Offer Sub which is to be merged into the Company pursuant to Section 2.01) issued and outstanding immediately prior to the Effective Time shall be converted into and become one validly issued, fully paid and non-assessable share of common stock of the Surviving Corporation ("Surviving Corporation Common Stock"). Immediately after the Effective Time, Parent shall be the holder of all outstanding shares of Surviving Corporation Common Stock.

2.04 Stock Options and Other Rights to Acquire Shares; Restricted Stock. (a) Immediately prior to the Effective Time and as part of the Merger, each holder of an outstanding option to purchase Shares or an alternate stock right (a "Stock Option") granted under the Company's 1974 Stock Incentive Program or 1980 Stock Incentive Program (collectively, the "Stock Option Plans") which is then exercisable in accordance with its terms (as in effect on the date of the Memorandum (as hereinafter defined)) will be entitled to receive in settlement thereof a cash payment from the Company in an amount equal to the excess of the Merger Consideration over the per Share exercise price of the Stock Option (provided that if an alternate stock right which shall be in tandem with a stock option shall have a lower exercise price than the related option, the holder thereof shall, with respect to any payment made pursuant to this Section 2.04(a), be entitled to the benefits of such lower exercise price), multiplied by the number of Shares issuable pursuant to such Stock Option. From and after the Effective Time, no Stock Option shall be exercisable for Shares or for shares of Surviving Corporation Common Stock or for shares of the common stock of Parent, and each such Stock Option outstanding immediately prior to the Effective Time shall represent only the right to receive a cash payment equal to the excess of the Merger Consideration over the per Share exercise price of the Stock Option (provided that if an alternate stock right which shall be in tandem with a stock option shall have a lower exercise price than the related option, the holder thereof shall, with respect to any payment made pursuant to this Section 2.04(a), be entitled to the benefits of such lower exercise price), multiplied by the number of Shares issuable pursuant to such Stock Option and shall be paid at the first opportunity that such Stock Option becomes exercisable in accordance with, and only to the extent provided by, its terms (as in effect on the date of the Memorandum, except as otherwise provided in the following sentence).

Notwithstanding the foregoing, subject to the provisions of Section 4.11 of this Agreement, after the Effective Time, if any employee of the Company holding a Stock Option at the time of the Offer (i) is terminated by the Company, (ii) resigns with the consent of the Company, or (iii) is re-assigned to significantly different responsibilities with the Company or there is a material change in the nature of the services required, the time of performance, the conditions of performance (including a decrease in compensation to be paid), or location of performance, in each case, without such employee's consent, the Stock Option of such employee shall become immediately exercisable in accordance with the preceding sentence. If an alternate stock right is in tandem with a stock option, the exercise of either or the making of a cash payment pursuant to this Section 2.04(a) in respect of either shall result in the cancellation of the other. The Company's Board of Directors and the Company's subsidiaries shall take such action prior to the Effective Time as may be required under the Stock Option Plans or otherwise to effectuate the foregoing.

(b) Prior to the Effective Time, the Company shall offer to purchase, at a price equal to the Merger Consideration, all shares of restricted stock issued to employees of the Company prior to March 1, 1985 pursuant to the Company's Stock Incentive Plan, which shares are currently considered to be outstanding shares, whether or not such shares are then vested. From and after the Effective Time, such shares shall not be convertible into or exchangeable for Shares or shares of Surviving Corporation Common Stock or shares of the common stock of Parent and the Company's Board of Directors shall take such action prior to the Effective Time (if necessary) as may be required to effectuate the foregoing.

2.05 Dissenting Shares. Notwithstanding anything in this Agreement to the contrary, Shares that are outstanding immediately prior to the Effective Time and are held by stockholders (other than Parent, Offer Sub or any subsidiary or parent of Parent or Offer Sub) who shall not have voted such Shares in favor of adoption of this Agreement and who shall have delivered to the Company a written demand for appraisal of such Shares in the manner provided in Section 262 of the GCL ("Dissenting Shares") shall not be converted into the right to receive, or be exchangeable for, the Merger Consideration, but the holders thereof shall be entitled to payment of the appraised value of such Shares in accordance with the provisions of such Section 262; provided, however, that (i) if any holder of Dissenting Shares shall subsequently deliver

a written withdrawal of his demand for appraisal of such Dissenting Shares (with the written approval of the Company, if such withdrawal is not tendered within 60 days after the Effective Time), or (ii) if any holder fails to establish his entitlement to appraisal rights as provided in such Section 262, or (iii) if neither any holder of Dissenting Shares nor the Surviving Corporation has filed a petition demanding a determination of the value of all Dissenting Shares within the time provided in such Section 262, such holder or holders (as the case may be) shall forfeit the right to appraisal of such Dissenting Shares and such Dissenting Shares shall thereupon be deemed to have been converted into the right to receive, and to have become exchangeable for, as of the Effective Time, the Merger Consideration.

2.06 Disbursing Agent. As soon as practicable after the Effective Time, the disbursing agent appointed by Parent to make payments of the Merger Consideration to former stockholders of the Company (the "Disbursing Agent") shall send a notice and a transmittal form to each holder of certificates formerly evidencing Shares (other than certificates formerly representing Shares to be cancelled pursuant to Section 2.03(b) of this Agreement and certificates representing Dissenting Shares) advising such holder of the effectiveness of the Merger and the procedure for surrendering to the Disbursing Agent such certificates for exchange into the Merger Consideration. Each holder of certificates theretofore evidencing Shares, upon proper surrender thereof to the Disbursing Agent together with and in accordance with such transmittal form, shall be entitled to receive in exchange therefor the Merger Consideration deliverable in respect of the Shares theretofore evidenced by the certificates so surrendered. Upon such proper surrender, the Disbursing Agent shall promptly deliver the Merger Consideration. Parent shall cause funds to be provided to the Disbursing Agent which are sufficient in amount to make such payments of the Merger Consideration to former stockholders of the Company, as and when certificates for Shares are properly surrendered. Until properly surrendered, certificates formerly evidencing Shares (other than Dissenting Shares) shall be deemed for all purposes to evidence only the right to receive the Merger Consideration. Notwithstanding the foregoing, neither the Disbursing Agent nor any party hereto shall be liable to a holder of certificates theretofore representing Shares for any amount which may be required to be paid to a public official pursuant to any applicable abandoned property, escheat or similar law.

2.07 No Further Rights. From and after the Effective Time, holders of certificates theretofore evidencing Shares shall cease to have any rights as stockholders of the Company, except as provided herein or by applicable law.

2.08 Closing of Company Transfer Books. After the Effective Time, there shall be no transfer of Shares which were outstanding immediately prior to the Effective Time.

2.09 Restated Certificate of Incorporation; By-laws; Directors; Officers. The Restated Certificate of Incorporation and By-laws of the Company in effect immediately prior to the Effective Time shall be the Certificate of Incorporation and By-laws of the Surviving Corporation until thereafter amended as provided therein and under the GCL. The directors of Offer Sub immediately prior to the Effective Time shall be the directors of the Surviving Corporation and the officers of the Company immediately prior to the Effective Time shall be the officers of the Surviving Corporation, in each case until their successors are duly elected and qualified.

ARTICLE III

REPRESENTATIONS AND WARRANTIES

3.01 Representations and Warranties of Parent and Offer Sub. Parent and Offer Sub hereby represent and warrant to the Company that:

(a) Organization. Each of Parent and Offer Sub is a corporation duly organized, validly existing and in good standing under the laws of its jurisdiction of incorporation and has the requisite corporate power to carry on its business as it is now being conducted.

(b) Authorization and Validity of Agreements. Each of Parent and Offer Sub has all requisite corporate power and authority to enter into this Agreement and to perform its respective obligations hereunder. Parent shall cause Offer Sub to perform all of its obligations hereunder. The execution, delivery and performance by each of Parent and Offer Sub of this Agreement, and the consummation by each of them of the transactions contemplated hereby, have been duly authorized by the Executive Committee of its Board of Directors or by its Board of Directors, respectively, and by Parent, as the sole stockholder of Offer Sub. No other corporate action on

the part of Parent or Offer Sub is necessary to authorize the execution, delivery or performance by Parent and Offer Sub of this Agreement and the consummation by Parent and Offer Sub of the transactions contemplated hereby. This Agreement has been duly executed and delivered by Parent and Offer Sub and is a valid and binding obligation of Parent and Offer Sub, enforceable against each of them in accordance with its terms.

(c) Financing. The information set forth in the second paragraph of Section 10 ("Source and Amount of Funds") of the Offer to Purchase does not, as of the date hereof, contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements therein not misleading.

3.02 Representations and Warranties of the Company.
The Company hereby represents and warrants to Parent and Offer Sub that:

(a) Organization. The Company and each of its subsidiaries is a corporation duly organized, validly existing and in good standing under the laws of its jurisdiction of incorporation and has all requisite corporate power and authority to own, lease and operate its properties and to carry on its business as now being conducted. Each of the Company and its subsidiaries is duly qualified or licensed as a foreign corporation to do business and is in good standing in each jurisdiction in which the property owned, leased or operated by it or the nature of the business conducted by it makes such qualification necessary, except where the failure to be so duly qualified or licensed would not have a material adverse effect on the financial condition, assets, liabilities, results of operations or businesses of the Company and its subsidiaries taken as a whole. True and complete copies of the Restated Certificate of Incorporation and By-laws of the Company have been delivered to Parent prior to the execution hereof.

(b) Capitalization. The authorized capital stock of the Company consists of 25,000,000 Shares and 6,000,000 shares of preferred stock, \$100 par value ("Preferred Stock"). As of March 25, 1985, 16,547,115 Shares were issued and outstanding, and 712,801 Shares were held in the Company's treasury. No shares of Preferred Stock are issued and outstanding or held in the Company's treasury. All outstanding Shares are validly issued, fully paid and nonassessable. As

of March 25, 1985, there were outstanding Stock Options to purchase an aggregate 407,453 Shares. Except for Stock Options, the Company does not have outstanding any subscriptions, options, warrants, rights, convertible securities or other agreements or commitments of any character relating to the issued or unissued capital stock or other securities of the Company obligating the Company to issue any securities.

(c) Authorization and Validity of Agreements.

The Company has all requisite corporate power and authority to enter into this Agreement and to perform its obligations hereunder (subject to obtaining the necessary approval of its stockholders). The execution, delivery and performance by the Company of this Agreement and the consummation by it of the transactions contemplated hereby have been duly authorized by the Company's Board of Directors and no other corporate action on the part of the Company is necessary to authorize the execution and delivery by the Company of this Agreement and the consummation by it of the transactions contemplated hereby other than obtaining the necessary approval of its stockholders. This Agreement has been duly executed and delivered by the Company and is the valid and binding obligation of the Company, enforceable against it in accordance with its terms.

ARTICLE IV

COVENANTS

4.01 Proxy Statement. As promptly as practicable after expiration of the Offer, the Company shall, if required by applicable law or otherwise deemed advisable by Parent, file with the Commission under the Exchange Act, and shall use all reasonable efforts to have cleared by the Commission, and as promptly as practicable thereafter shall mail to its stockholders, a proxy statement or information statement, as appropriate (the "Proxy Statement"), with respect to the Special Meeting (as such term is defined in Section 4.02 of this Agreement). In the Proxy Statement, the Company's Board of Directors shall, subject to its fiduciary responsibilities and obligations under applicable laws, as advised in the opinion of its counsel, recommend to the stockholders of the Company approval of the Merger.

4.02 Meeting of Stockholders of the Company. If required by the GCL, promptly after expiration of the Offer, the Company shall take all action necessary, in accordance

with the GCL and its Restated Certificate of Incorporation and By-laws, to convene a meeting of its stockholders (the "Special Meeting") as promptly as practicable to consider and vote on this Agreement. Pursuant to Section 228 of the GCL, any action to be taken at the Special Meeting may be taken by means of the written consent of the Company's stockholders. Subject to fiduciary responsibilities and obligations under applicable law, as advised in the opinion of its counsel, the Company shall use its best efforts to solicit from stockholders of the Company proxies in favor of the adoption of this Agreement and to take all other action necessary or, in the reasonable judgment of Parent, helpful to secure a vote of stockholders in favor of the adoption of this Agreement. At the Special Meeting, Parent shall vote, or cause to be voted, all of the Shares then owned by Parent (or any direct or indirect subsidiary of Parent) in favor of the adoption of this Agreement.

4.03 Merger Without Approval of Stockholders. Notwithstanding the foregoing, in the event that Parent, Offer Sub or any parent or subsidiary of Parent or Offer Sub shall own in the aggregate at least 90 percent of the outstanding Shares, the parties hereto agree, at the request of Parent, to take all necessary and appropriate action to cause a merger of the Company and Offer Sub to become effective without approval of stockholders of the Company, in accordance with Section 253 of the GCL.

4.04 Acquisition Proposals. The Company, its subsidiaries and the affiliates of the Company which it controls shall not, directly or indirectly, (a) solicit, initiate or encourage submission of proposals or offers from any person relating to any acquisition or purchase of all or a material amount of the assets of, or any equity interest in, the Company or any of its subsidiaries or any merger, consolidation or business combination with the Company or any of its subsidiaries, or (b) participate in any substantive discussions or any negotiations regarding, or knowingly furnish to any other person any information with respect to, or otherwise cooperate in any way with, or assist or participate in, facilitate or encourage, any effort or attempt by any other person to do or seek any of the foregoing. The Company shall use its best efforts to ensure that its officers, employees, directors, representatives, agents and affiliates (other than affiliates to which the first sentence of this Section 4.04 shall apply) shall not, directly or indirectly, take any action referred to in the first sentence of this Section.

The Company shall promptly notify Parent if any such proposal or offer, or any inquiry or contact with any person with respect thereto, is made.

4.05 Interim Operations. During the period from March 25, 1985 to the Effective Time, except as specifically contemplated by this Agreement or the Memorandum, or otherwise as consented to or approved in writing by Parent:

(a) the business of the Company and each of its subsidiaries shall be conducted only in, and the Company and its subsidiaries shall not take any action except in, the ordinary and usual course of its businesses;

(b) neither the Company nor its subsidiaries shall make or propose any change or amendment in their respective charters or By-laws;

(c) neither the Company nor its subsidiaries shall issue or sell any shares of its capital stock or any of its other securities or issue any securities convertible into or exchangeable for, or options, warrants to purchase, scrip, rights to subscribe for, calls or commitments of any character whatsoever relating to, or enter into any contract, understanding or arrangement with respect to the issuance of, any shares of its capital stock or any of its other securities other than, in the case of the Company, Shares issuable pursuant to the terms of presently outstanding Stock Options as in effect on March 27, 1985, or enter into any arrangement or contract with respect to the purchase of shares of its capital stock, or adjust, split, combine or reclassify any of its securities, or make any other changes in its equity capital structure;

(d) the Company shall not declare, pay or make any dividend or other distribution or payment with respect to, or purchase or redeem, any shares of its capital stock other than regular quarterly cash dividends of not more than \$.50 per Share declared and paid in accordance with prior practice.

(e) the Company shall use its best efforts to preserve the goodwill of those having business relationships with it and its subsidiaries;

(f) neither the Company nor any of its subsidiaries shall: grant any general increase in the compensation of officers or employees (including any such increase pursuant to any bonus, pension, profit-sharing or other plan or commitment) or any increase in the compensation payable or to

become payable to any officer or employee, except for reasonable increases in the ordinary course of business, consistent with past practice of the Company, or increases required under collective bargaining agreements, or enter into any employment agreements;

(g) except with respect to the endorsement of negotiable instruments in the ordinary course of its business, neither the Company nor any of its subsidiaries shall (i) incur or assume any material indebtedness for money borrowed or (ii) guarantee any such indebtedness except, in each case, in the ordinary course of business within existing credit lines;

(h) the Company shall not and shall not permit any subsidiary to sell, lease or otherwise dispose of any of its assets which are material, either individually or in the aggregate, to the Company or any of its subsidiaries; and

(i) except as may be required by law, neither the Company nor any of its subsidiaries shall take any action to terminate or amend any of its employee benefit plans within the meaning of Section 3(2) of the Employment Retirement Income Security Act of 1974, as amended.

4.06 Appraisal Rights. The Company shall not settle or compromise any claim for appraisal rights under the GCL prior to the Effective Time without the prior written consent of Parent.

4.07 Pension Benefits. It is understood and agreed that the Company's Pension Benefit Replacement Plan has been amended to provide for payment thereunder of those additional benefits that would have been provided under the Company's Salaried Employee's Retirement Plan II ("Plan II") if Plan II had been amended (i) to recognize an additional three years of credited service and benefit service (or such lesser amount as would grant full service credit to age 65) for those eight (8) individuals who receive payments under the Company's Key Executive Severance Pay Plan ("Severance Plan"), and (ii) to take payments under the Severance Plan (base salary and annual incentive bonus) into account in determining "final average base earnings" in calculating benefit payments under Plan II based upon all benefit service, as if such payments were paid as compensation during the additional years of benefit service recognized under (i) above. Parent's obligations pursuant to this Section 4.07 are subject to the condition that such payments be deductible by the Surviving

Corporation as ordinary and necessary business expenses when the payments are funded or included in the individual's income.

4.08 Additional Agreements. (a) The Company shall, and shall cause each of its subsidiaries to, afford Parent, Offer Sub and their respective counsel, accountants and other authorized representatives, reasonable access during normal business hours throughout the period prior to the Effective Time to all of its properties, books, contracts, commitments, records, tax records and accountants' working papers. During such period, the Company shall, and shall cause each of its subsidiaries to, furnish promptly to Parent (i) a copy of each report, schedule and other document filed or received by it pursuant to the requirements of federal or state securities laws in the last three years or for such earlier periods as Parent shall reasonably request and (ii) all such other information concerning its business, properties and personnel as Parent may request and which is customarily prepared by the Company or is in the Company's possession, provided that no investigation pursuant to this Section 4.07(a) shall affect or be deemed to modify any representations or warranties made in this Agreement or the conditions to the obligations of the parties to consummate the Merger under this Agreement or to purchase or pay for Shares pursuant to the Offer.

(b) Parent and Offer Sub agree that each of them shall, and shall use all reasonable efforts to cause its officers, employees and authorized representatives to, hold in strict confidence all data and information obtained by them from the Company or its subsidiaries (unless such information is or becomes readily ascertainable from public or published information or trade sources or public disclosure of such information is required by law) and shall use all reasonable efforts to ensure that such officers, employees and authorized representatives do not disclose such information to others without the prior written consent of the Company.

(c) In the event of the termination of this Agreement, Parent and Offer Sub shall return promptly every document furnished to them by the Company or any subsidiary in connection with the transactions contemplated hereby and any copies thereof which may have been made, and shall use all reasonable efforts to cause their representatives and others to whom such documents were furnished promptly to return such documents and any copies thereof any of them may have made, other than documents filed with the Commission or otherwise publicly available.

(d) Each of the parties hereto agrees to use all reasonable efforts to take, or cause to be taken, all action and to do, or cause to be done, all things necessary, proper or advisable to consummate and make effective the transactions contemplated by this Agreement, including using all reasonable efforts to (i) obtain all necessary waivers, consents and approvals and effect all necessary registrations and filings, including, but not limited to, (x) filings under the Hart-Scott-Rodino Antitrust Improvements Act of 1976, as amended (the "Hart-Scott Act"), including responses as promptly as practicable to requests for additional information, and (y) submissions of information requested by government authorities, and (ii) rectify any event or circumstance which would impede consummation of the transactions contemplated hereby, including, without limitation, causing any injunction or other order which impedes any of such transactions to be lifted.

(e) The Company hereby waives any and all rights to any benefit or otherwise, including any right of action, that it may have under Section 203 of the GCL.

(f) After the Effective Time, Parent agrees that it shall, or shall cause the Surviving Corporation to, make the severance payments described in paragraph 5 of the Memorandum dated March 27, 1985 between Parent and the Company (the "Memorandum").

4.09 Bonus Plan. After the Effective Time, Parent shall cause the Surviving Corporation to pay on January 1, 1986, pursuant to the Company's Management Incentive Compensation Plan ("MIC") and Middle Management Incentive Compensation Plan ("MMIC") and consistent with past practices, to any exempt management employees employed at the Company's corporate office during the full period from January 1, 1985 through April 24, 1985, a bonus for 1985 equal in amount to at least one-third of the maximum bonus to which such person is eligible under the MIC and MMIC plans, so long as such person does not voluntarily terminate his or her employment with the Company or the Surviving Corporation prior to December 31, 1985. For the purpose of this Section 4.09, Parent agrees that a voluntary termination shall not occur if any employee terminates his or her employment because of a material change in the nature of the services required, the time of performance, the conditions of performance (including a decrease in the level of compensation) or the location of performance.

4.10 Key Executive Severance Plans. After the Effective Time, Parent shall cause the Surviving Corporation to pay to any employee any amounts payable to such employee pursuant to the terms of the Severance Plan, in the form delivered to Parent prior to the execution of this Agreement, upon the termination of the employment of such employee, subject to the conditions and limitations of such Plan, it being agreed that no more than the eight individuals previously identified to Parent may receive payments pursuant to the Plan.

4.11. Right to Waive; No Payment for Taxes. Any of the persons covered by Section 4.10 shall have the right to waive in writing (whether or not such waiver is irrevocable) receipt of all or any portion of the payments contemplated by this Agreement or the Memorandum. Parent shall cause the Company to (i) inform such persons of the right to make such waiver within a period of 180 days after the Effective Time and (ii) make payments in the amounts set forth in such waiver (to the extent not waived). Notwithstanding any other provision of this Agreement, Parent, Offer Sub, the Company and the Surviving Corporation shall not make or increase any payment to any employee to reimburse such employee for any tax liability on account of any payments contemplated hereby. Parent shall accept the return of payments from an employee which have not been waived pursuant to this Section 4.11.

ARTICLE V

CONDITIONS

5.01 Conditions to the Obligations of Each Party. The respective obligations of each party hereto to consummate the Merger shall be subject to the fulfillment at or prior to the Effective Time of the following conditions:

(a) Approval of Stockholders. The approval of the stockholders of the Company referred to in Section 4.02 of this Agreement shall have been obtained, if required by applicable law.

(b) Hart-Scott. Any applicable waiting period (and any extension thereof) applicable to the Merger under the Hart-Scott Act shall have expired or been terminated.

(c) Litigation. No preliminary or permanent injunction or other order, decree or ruling issued by a court of competent jurisdiction in the United States or by a United States federal or state governmental, regulatory or administrative agency or commission, and no statute, rule, regulation or executive order promulgated or enacted by any governmental authority shall be in effect which would prevent the consummation of the Merger.

5.02 Conditions to the Obligations of Parent and Offer Sub. The obligations of Parent and Offer Sub to consummate the Merger shall be subject to the fulfillment at or prior to the Effective Time of the additional condition that Parent or an affiliate thereof shall have purchased all Shares validly tendered and not withdrawn pursuant to the Offer.

5.03 Conditions to the Obligations of the Company The obligations of the Company to consummate the Merger shall be subject to the fulfillment at or prior to the Effective Time of the additional condition that Parent or an affiliate thereof shall have purchased all Shares validly tendered and not withdrawn pursuant to the Offer.

ARTICLE VI

MISCELLANEOUS

6.01 Termination. This Agreement may be terminated at any time prior to the Effective Time, whether or not it has been approved by the stockholders of the Company:

(a) by the mutual written consent of the Board of Directors of the Company and the Board of Directors of Parent;

(b) by Parent if the Offer is terminated or Shares are not purchased or paid for pursuant to the Offer due to the occurrence of any of the conditions set forth in Section 16 of the Offer to Purchase, as amended by this Agreement;

(c) by the Company if the Offer is terminated due to the occurrence of any of the conditions set forth in Section 16 of the Offer to Purchase, as amended by this Agreement;

(d) if Parent or Offer Sub shall not have purchased Shares pursuant to the Offer, by either Parent or the Company

if the Merger has not been consummated on or before September 1, 1985, which date may be extended by the mutual written consent of the Board of Directors of the Company and the Board of Directors of Parent; or

(e) by either Parent or the Company if any permanent injunction or other final nonappealable order, decree or ruling issued by a court of competent jurisdiction within the United States is in effect which would prevent the consummation of the Merger.

6.02 Liabilities in Event of Termination. In the event of any termination of this Agreement pursuant to Section 6.01 of this Agreement, the Company, Parent and Offer Sub shall have no obligation or liability to each other except as provided in Sections 4.08(b) and (c) and 6.04(c) and except that nothing herein will relieve any party from liability for any willful breach of this Agreement.

6.03 Survival. None of the representations, warranties or covenants contained in this Agreement shall survive the Merger except as provided in Sections 2.04 (a) (second and third sentences), 2.06, 4.07, 4.08(f), 4.09, 4.10, 4.11 (second sentence), 6.05 and 6.07.

6.04 Fees and Expenses. (a) Except as otherwise contemplated by this Agreement, each party hereto shall pay its own costs and expenses incident to its negotiation and preparation of this Agreement and to its performance of and compliance with all agreements and conditions contained herein to be performed or complied with by it.

(b) Except for Goldman, Sachs & Co. and a reimbursement of expenses of not more than \$1,205,000 payable to Forstmann Little & Co., the Company hereby represents and warrants to Parent with respect to the Company, and except for Morgan Stanley & Co. Incorporated, Parent hereby represents and warrants to the Company with respect to Parent, that no person or entity is entitled to receive from the Company or Parent, respectively, any brokerage, finder's or other similar fee or commission in connection with the Offer or the Merger or the transactions contemplated by this Agreement or any proposed transaction or arrangement with Forstmann Little & Co. or relating thereto.

(c) In the event that (i) the Board of Directors of the Company withdraws its recommendation of the Offer or of the Merger or recommends a proposal by a party other than Parent or an affiliate of Parent for the acquisition of the

Company or (ii) if anyone (other than Parent or an affiliate of Parent) acquires more than 25% of the Shares outstanding as of the date hereof, then the Company shall reimburse Parent for expenses incurred in connection with its proposed acquisition of the Company, whether or not incurred prior to, at or after the date hereof, provided that the Company shall not be obligated to pay Parent more than \$3 million pursuant to this Section 6.04.

6.05 Indemnification and Insurance. Parent agrees that all rights to indemnification now existing in favor of the employees, agents, directors or officers of the Company (the "Indemnified Parties") as provided in the charter or by-laws of the Company in effect on the date of the Memorandum shall survive the Merger and shall continue in full force and effect for a period of 5 years from the Effective Time. Without limiting the foregoing, in the event any Indemnified Party becomes involved in any capacity in any action, proceeding or investigation in connection with any matter, including the transactions contemplated hereby, occurring prior to, and including, the Effective Time, Parent will, subject to the provisions of Section 145(e) of the GCL relating to the receipt of an undertaking in connection with the advancement of expenses, periodically advance to such Indemnified Party its legal and other expenses (including the cost of any investigation and preparation incurred in connection therewith). Parent shall cause to be maintained in effect for not less than one year from the Effective Time the current policies of the directors' and officers' liability insurance maintained by the Company (provided that Parent may substitute therefor policies of at least same coverage containing terms and conditions which are no less advantageous so long as no lapse in coverage occurs as a result of such substitution) with respect to all matters, including the transactions contemplated hereby, occurring prior to, and including, the Effective Time.

6.06 Waiver and Amendment. Any provision of this Agreement may be waived at any time by the party which is, or whose stockholders are, entitled to the benefits thereof. This Agreement may not be amended or supplemented at any time except by an instrument signed on behalf of each party hereto; provided, that after this Agreement has been adopted by the stockholders of the Company no such amendment shall reduce the amount or adversely change the consideration to be paid to the stockholders of the Company in the Merger or alter or change any of the terms or conditions of this Agreement if such alteration or change would adversely affect the stockholders of the Company.

6.07 Employee Benefit Plans. After the Effective Time, Parent agrees to cause the Surviving Corporation to continue in effect the present incentive compensation and employee benefit plans of the Company with the same rights to amend or terminate such compensation or benefit plans as exist as of the date of the Memorandum.

6.08. Applicable Law. This Agreement shall be governed by and construed in accordance with the substantive law of the State of Delaware without giving effect to the principles of conflicts of laws thereof.

6.09 Section Headings. The descriptive headings contained herein are for convenience of reference only and shall not affect in any way the meaning or interpretation of this Agreement.

6.10 Notices. All notices or other communications hereunder shall be in writing and shall be deemed to have been duly given if delivered personally or sent by registered or certified mail, postage prepaid, with return receipt requested, addressed as follows:

If to Parent
or Offer Sub, to: Cooper Industries, Inc.
First City Tower Suite 4000
P.O. Box 4446
Houston, Texas 77210

Attention: Alan E. Riedel

With copies to:

Vinson & Elkins
First City Tower
Houston, Texas 77002

Attention: Campbell A. Griffin, Jr.

and

Wachtell, Lipton Rosen & Katz
299 Park Avenue
New York, New York 10171

Attention: Lawrence Lederman

If to the Company to: McGraw-Edison Company
One Continental Towers
1701 Golf Road
Rolling Meadows, Illinois 60008

Attention: William R. Rawson

With a copy to: McDermott, Will & Emery
111 West Monroe Street
Chicago, Illinois 60603

Attention: Frank E. Babb

Skadden, Arps, Slate,
Meagher & Flom
919 Third Avenue
New York, New York 10022

Attention: Roger Aaron

6.11 Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original but all of which together shall be deemed to be one and the same instrument.

6.12 Assignment. This Agreement may be assigned by Parent to any direct or indirect wholly owned subsidiary of Parent, but no such assignment shall relieve Parent of its obligations under this Agreement if Parent's assignee does not perform such obligations. Except as set forth in the preceding sentence, this Agreement shall not otherwise be assignable without the prior written consent of the Company.

6.13 Specific Performance. The parties hereto acknowledge that the award of damages would be an inadequate remedy for any breach of any of the provisions of this Agreement and agree that the remedy of specific performance shall be available to enforce the obligations of the parties hereunder.

6.14 Severability. If any term, provision, covenant or restriction of this Agreement shall be held by a court of competent jurisdiction to be invalid, void or unenforceable, the remainder of the terms, provisions, covenants and restrictions of this Agreement shall remain in full force and effect and shall in no way be affected, impaired or invalidated.

IN WITNESS WHEREOF, each of the parties hereto,
has caused this Agreement to be executed on its behalf by its
officers thereunto duly authorized, all as of the day and
year first above written.

COOPER INDUSTRIES, INC.

By /s/ Roger A. Scott

Attest:

/s/ Campbell A. Griffin, Jr.
Assistant Secretary

CI ACQUISITION COMPANY

By /s/ Roger A. Scott

Attest:

/s/ Campbell A. Griffin, Jr.
Assistant Secretary

MCGRAW-EDISON COMPANY

By /s/ Edward J. Williams

Attest:

/s/ William R. Rawson
Secretary

SCHEDULE A

(a) any change (or any condition, event or development involving a prospective change) shall have occurred in the business, properties, financial condition, results of operations or prospects of the Company or any of its subsidiaries, which, in the sole judgment of the Purchaser, is or may reasonably be expected to be materially adverse to the Company and its subsidiaries taken as a whole;

(b) any action or proceeding shall be taken or instituted, or any statute, rule, regulation, judgment, order or injunction shall be introduced (with reasonable prospect of passage), enacted, promulgated, entered, enforced or deemed applicable to the Offer or the merger provided for in the Agreement and Plan of Merger (the "Merger Agreement") dated March 29, 1985 among the Company, the Purchaser and Cooper (the "Merger"), by or before any domestic court or governmental, administrative or regulatory agency, authority or instrumentality, or any official or representative of any of the foregoing, or by any other person, domestic or foreign, which (i) challenges the making or completion of the Offer or the Merger, (ii) would or, in the sole judgment of the Purchaser, is reasonably expected to restrict the ability of the Purchaser or Cooper to accept for payment or to pay for some or all of the Shares pursuant to the Offer, or to make the consummation of the Offer or Merger unduly burdensome to the Purchaser or Cooper, (iii) would or, in the sole judgment of the Purchaser, is reasonably expected to render the Purchaser or Cooper unable to accept for payment or to pay for some or all of the Shares pursuant to the Offer, (iv) would or, in the sole judgment of the Purchaser, is reasonably expected to make the acceptance for payment or payment for some or all of the Shares illegal or otherwise restrict or prohibit consummation of the Offer or the Merger, (v) seeks to or would prohibit ownership or require the divestiture by Cooper or the Purchaser or any of Cooper's subsidiaries or affiliates of any Shares or impose any material limitation on the ability of any of them to acquire or own Shares, (vi) may impose any limitation on the ability of the Purchaser or Cooper or any of Cooper's subsidiaries or affiliates to exercise effectively all rights of ownership with respect to the Shares, including the right to vote all Shares purchased by it on all matters properly presented to the stockholders of the Company, (vii) may impose any limitation upon the ability of the Purchaser or Cooper or any of Cooper's subsidiaries or affiliates effectively to control in any respect the businesses or operations of the Company or the Purchaser or Cooper

or any of their respective subsidiaries or affiliates, (viii) may prohibit or impose any limitation upon the Purchaser's or Cooper's ownership or operation of all or any material portion of the businesses or assets or properties of the Purchaser, Cooper or the Company (or any of their respective subsidiaries or affiliates) or compel the Purchaser, Cooper or the Company to divest or hold separate all or any material portion of the businesses or assets of the Purchaser, Cooper or the Company (including the businesses or assets of any of their respective subsidiaries and affiliates) or impose any limitation on any of them in the conduct of their businesses, or (ix) may otherwise adversely affect the Purchaser, Cooper or the Company or any of their respective subsidiaries or affiliates;

(d) the Company, and Cooper or the Purchaser, shall have reached an agreement or understanding that the Offer be terminated or amended (other than any amendment of the Offer expressly provided for in the Merger Agreement);

(f) a tender or exchange offer for any Shares shall have been made or publicly proposed to be made by another person, or it shall have been publicly disclosed or the Purchaser shall have learned that (i) any person, entity or "group" (as that term is used in Section 13(d)(3) of the Exchange Act) shall have acquired, or proposed to acquire, or shall have been formed which holds, more than 10% of the Shares, or shall have been granted any option or right, conditional or otherwise, to acquire more than 10% of the Shares, other than acquisitions for bona fide arbitrage purposes and other than acquisitions by any person, entity or group which has publicly disclosed such ownership in a Schedule 13D or 13G (or an amendment thereto) on file with the Commission on or prior to March 12, 1985, or (ii) any such person, entity or group which has publicly disclosed such ownership prior to such date shall have acquired or proposed to acquire additional Shares constituting more than 5% of the Shares or shall have been granted any option or right to acquire more than 5% of the Shares (except for acquisitions of Shares by the McGraw-Edison Company Profit Sharing Trust in accordance with the terms of such Trust in effect prior to the Offer, as disclosed in the Company's filings with the Commission made prior to March 22, 1985);

(g) the Purchaser shall discover that any representation or warranty made by the Company in the Merger Agreement is untrue in any material respect;

(h) the Company shall not have complied in all material respects with its obligations in the Merger Agreement; or

(i) the Merger Agreement shall have been terminated in accordance with its terms;

129
November 8, 1904.

S. Bergmann, Esq.,
23 Oudenarder Strasse,
Berlin, Germany.

My dear Bergmann:

Am glad to hear you have put the Company affairs through. Have seen Lansden ~~and told him to hurry the delivery wagon along and ship at the earliest possible moment. The best large truck that I have seen was built for the New York Edison Co. by the Electric Vehicle Co. of Hartford, it carries several tons, has hoisting apparatus with separate motor and is all right, except that perhaps it would be improved by using a chain instead of pinion from motor to jack. It drives the wheel with chain, 2 motors, its expensive costs four to five thousand. I will correspond with them and get you photographs and data as to cost and delivery.~~ and told him to hurry the delivery wagon along and ship at the earliest possible moment. The best large truck that I have seen was built for the New York Edison Co. by the Electric Vehicle Co. of Hartford, it carries several tons, has hoisting apparatus with separate motor and is all right, except that perhaps it would be improved by using a chain instead of pinion from motor to jack. It drives the wheel with chain, 2 motors, its expensive costs four to five thousand. I will correspond with them and get you photographs and data as to cost and delivery.

Regarding battery: I have laid off the manufacturing force at Glen Ridge for a while, as the welded cans in wagons outside developed entirely too many leaks, pretty nearly every can showed exceedingly fine hair like holes which were so small that no liquid showed, but what came through came so slowly that the potash evaporated as fast as liquid leaked and left the side seam with little white patches. Some seams would show 5 to 8 white spots, others only one. We are now experimenting to get best way to solder

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STORAGE BATTERIES

STORAGE BATTERIES

A General Treatise on the Physics
and Chemistry of Secondary Batteries
and their Engineering Applications

GEORGE WOOD VINAL, Sc. D.

Formerly Physicist, National Bureau of Standards
Fellow, American Institute of Electrical Engineers
Member, The Electrochemical Society

FOURTH EDITION

New York · JOHN WILEY & SONS, Inc.

London · Sydney

Contents

1. INTRODUCTION	1
Historical Development of the Lead-Acid Battery	1
The Storage-Battery Industry	6
The Grouping of Cells	9
2. MATERIALS AND METHODS OF MANUFACTURE	12
Materials for Lead-Acid Batteries	12
Pasted Plates	27
Planté Plates	46
Separators for Lead-Acid Cells	51
Vent Plugs	69
Assembly of Lead-Acid Cells	70
Types of Lead-Acid Cells	71
Hazards in the Process of Manufacture	83
The Edison Cell (Alkaline Type)	85
Nickel-Cadmium Cells (Alkaline Type)	95
Silver Oxide Batteries	100
3. THE ELECTROLYTE	103
The Production of Sulfuric Acid	103
Properties of Sulfuric Acid Solutions	106
Measurement of Sulfuric Acid Solutions	120
Preparation of the Electrolyte	128
Choice of Specific Gravities for Battery Service	130
Purity of the Electrolyte	131
Battery Additives	157
Properties of Alkaline Electrolytes	159
4. THEORY OF REACTIONS, ENERGY TRANSFORMATION, AND VOLTAGE	166
Elementary Theory of Electric Cells	166
Theory of the Lead-Acid Cells	174
Energy Transformations	183
Electromotive Force	186

THE EDISON CELL (ALKALINE TYPE)

Positive Plates

The positive plates of Edison alkaline batteries are filled with nickelous hydroxide which is converted to a higher oxide of nickel by the process of formation. Since this material is a non-conductor, additions of flake nickel or graphite are made to provide the necessary conductivity. An early form of Edison cell employed graphite for this purpose, but with the change in construction of Edison cells in 1908 the use of graphite was discontinued, flake nickel being used in its place. Some other alkaline batteries, however, use graphite.

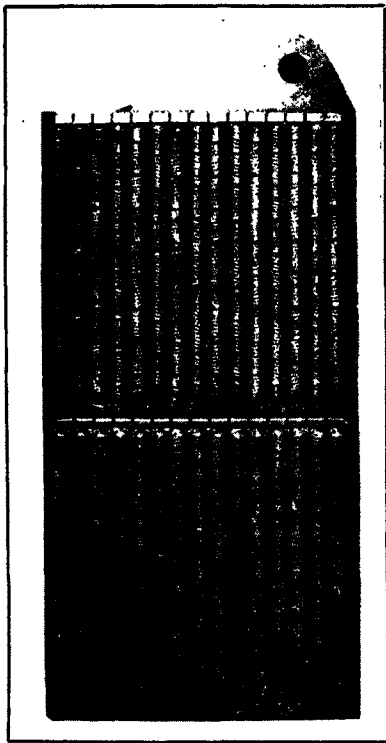


Fig. 34. Positive plate of the Edison cell, type A.

A positive plate is shown in Fig. 34.

The electrolyte for all these alkaline cells is a solution of potassium hydroxide in water. To this a small amount of lithium hydroxide is always added for the Edison cells.

Preparation of Nickelous Hydroxide. Metallic nickel in finely divided form is dissolved in sulfuric acid. The hydrogen which is evolved during this process is collected and saved for use in connection with other processes in the manufacture of the cell. Certain impurities, such as copper, zinc, antimony, and iron, are usually present in the solution and must be removed. The solution of nickel sulfate is then sprayed into tanks containing a solution of hot sodium hydroxide. Nickelous hydroxide is precipitated as a result of the reaction that takes place. The precipitate is collected and dried, but it contains considerable amounts of sodium hydroxide, carbonates, and sulfates. These may be removed by leaching the mass with hot water. The nickelous hydroxide is then dried again and tested to determine its quality. If it is found to be satisfactory it is ground and sifted, the material used ranging between 30 and 190 mesh.

Preparation of the Flake Nickel. The flake nickel which is added to the nickelous hydroxide in making the plates is required to give the active material sufficient electrical conductivity. The flake nickel consists of small squares $\frac{1}{16}$ inch on the edge and 0.00004 inch in thickness. It is prepared by an interesting nickel-plating process. Ten revolving copper cylinders are carried by a crane and dipped alternately in copper- and nickel-plating baths for sufficient time to deposit the thin layers of metal which are required. The cylinders are washed by sprays of water between each immersion in the plating tank. This process of alternately plating copper and nickel is repeated 160 times so that the sheet of deposited metal on the cylinders consists of 160 layers each of copper and nickel. The copper-nickel sheet is then stripped from the cylinders and cut into squares $\frac{1}{16}$ inch on the edge. The copper is dissolved chemically, leaving the nickel as thin flakes, each little square yielding 160 of these flakes. The flake nickel is washed and centrifuged and dried over steam coils. In its final state a bushel of the material weighs only $4\frac{1}{2}$ pounds.

Fig. 35. Positive tube of Edison cell.

Tubes to Contain the Active Material. Since 1908, the active material for the positive plates of the Edison batteries has been contained in steel tubes (Fig. 35). Prior to this time the material was contained in pockets somewhat similar to those which are used for the negative plates. This earlier construction was abandoned because of the strains created by the swelling of the active material. The tubes are prepared from cold-rolled carbon-steel ribbon which is perforated by passing through special rolls that punch 560 holes to the square inch. The burrs are removed by emery wheels and the ribbon is cleaned by revolving wire brushes, to insure that the perforations are open so that the electrolyte may have free access to the active material of the plate. The steel ribbon is then nickel-plated. This is done as it passes continuously through a series of tanks containing the necessary solutions for cleaning, plating, and washing. The first of these tanks contains a solution of sodium carbonate to remove the grease from the steel ribbon. This is followed by a tank of hot water to wash off

the alkali. The next tank contains a solution of nickel sulfate, in which the nickel plating is done. This is followed by two washing tanks containing hot and cold water, and finally the steel ribbon is passed through a tank containing a dilute solution of ammonium hydroxide. The time required for a given point on this ribbon to pass through the series of plating and other baths is about 8 minutes. After the nickel-plating process is finished, the ribbon is dried and annealed in an atmosphere of hydrogen. The purpose of this annealing is to fuse together the nickel plate and the underlying steel in order to prevent possible scaling off of the nickel plating. This is done in an atmosphere of hydrogen to prevent oxidation or discoloration that might otherwise take place.

The tubes which contain the active material of the positive plates are made from the nickel-plated steel ribbon, by winding it spirally. The seams are lapped and swaged flat. These tubes are made in rights and lefts, which are alternated in the assembly of the plate, thereby equalizing the strains which would tend to cause buckling. The tubes are made $\frac{3}{4}$ inch in diameter with a standard length of $4\frac{1}{2}$ inches.

Filling the Tubes. A cap is placed at the bottom of each tube, and a group of tubes is then put into a filling machine which tamps the active material into them. Eight tubes are mounted in molds below a row of weighted ramrods that fall by gravity, striking a blow of 2000 pounds per square inch. The filling machine is provided with two hoppers, one of which dumps a specified charge of nickelous hydroxide into each tube, and the other a certain quantity of the flake nickel. This is followed by a blow of the ramrod. The process is repeated 315 times, so that there are 630 layers of alternate nickelous hydroxide and flake nickel (Fig. 36). The layer of the nickel is somewhat thinner than the layer of the hydrate, the nickel constituting about 14 per cent of the contents of the tube. After the tubes are completely filled, the ends are pinched shut to form terminals which are suitable for clamping into steel grids. Before being placed in the grids, however, the tubes are reinforced by eight seamless nickel-plated steel rings. These are put on each tube to prevent possible bursting of the tube because of the swelling of the active material which takes place during the forming process. The active material of the positive plate is said to contract somewhat on discharge.

Positive Grids. These are steel punchings (Fig. 37) which are nickel-plated and annealed as has been described above. The pinched ends of the tubes are caught underneath ears projecting from the sides of the plate. The tubes are clamped in place by a hydraulic press.



Fig. 36. Magnified section vertically through a positive tube, showing the alternate layers of nickelous hydroxide and flake nickel.

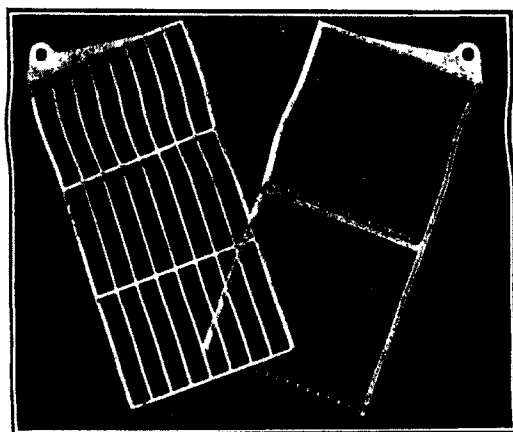


Fig. 37. Grids of the Edison cell: negative left, positive right.

Negative Plates

The negative plates of the Edison type are filled initially with a finely divided mixture of metallic iron, ferrous oxide, and mercuric oxide. Negative plates of the Jungner cells contain a mixture of iron and cadmium. At one time cadmium alone was tried in these cells. The combination, however, proved to be better suited to the purpose.

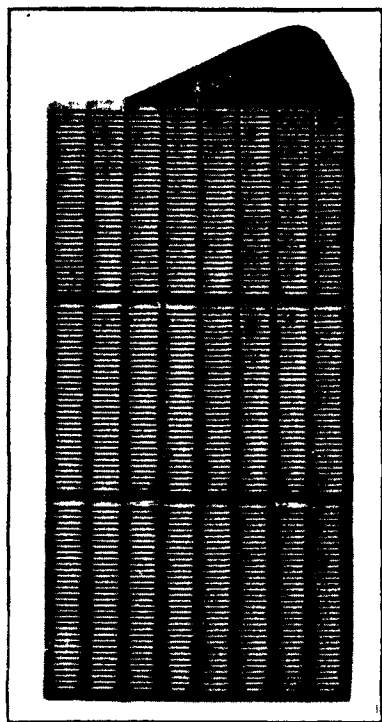


Fig. 38. Negative plate of the Edison cell, type A.

A negative plate is shown in Fig. 38.

Active Material. Pure iron is dissolved in sulfuric acid. Hydrogen gas is evolved during this process, and this is saved for other uses in the manufacture of the batteries. The iron, in the form of ferrous sulfate, is recrystallized and then centrifuged to free it from mother liquor. It is dried at temperature of 500°C and roasted in an oxidizing atmosphere to the ferric state (Fe_2O_3). Traces of sulfate in this material are removed by leaching, and it is dried and reduced in an atmosphere of hydrogen in a muffle furnace. It is then partially oxidized to ferrous oxide, after which it is dried and ground.

Negative Pockets. The active material for the negative plates is contained in steel pockets (Fig. 39) with perforated sides. These are prepared from nickel-plated ribbon similar to that used for making

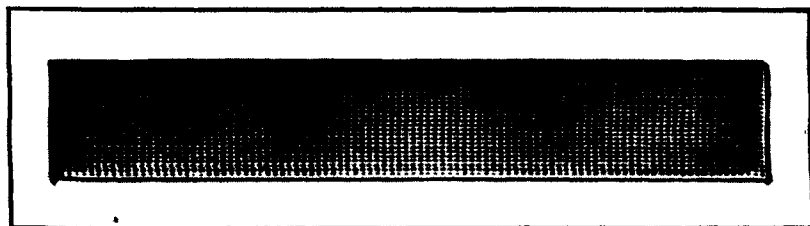


Fig. 39. Negative pocket of Edison cell.

positive tubes but more finely perforated. The ribbon is cut to the proper length and pressed into a form similar to a box, one end being left open for filling with active material. The pockets are fastened in the negative grid (Fig. 37), which is a nickel-plated steel punching having a series of parallel openings of the proper size to take the pockets of active material. The pockets are put in place, and a hydraulic press seals the boxes and crimps the sides. The dimensions of the pockets are given in Table 10.

TABLE 10. TYPES OF EDISON STORAGE-BATTERY PLATES

The types of plates are designated by letters; the types of cells by letters and numbers, the former indicating the type of plate and the latter the number of positive plates in the cell, except in type M. Ratings are based on 5-hour discharge for types A, B, C, D, M, N, F.

Type of Plate	Number of Tubes per Positive Plate	Dimensions of Tubes		Number of Pockets per Negative Plate	Dimensions of Pockets			Nominal Capacity per Positive Plate, amp-hr
		Diameter, in.	Length, in.		Length, in.	Width, in.	Thickness, in.	
A	30	$\frac{1}{4}$	$4\frac{1}{2}$	24	3	$\frac{1}{2}$	$\frac{1}{8}$	37.5
B	15	$\frac{1}{4}$	$4\frac{1}{2}$	16	$2\frac{5}{8}$	$\frac{1}{2}$	$\frac{1}{8}$	18.75
C	45	$\frac{1}{4}$	$4\frac{1}{2}$	40	*	$\frac{1}{2}$	$\frac{1}{8}$	56 25
D	60	$\frac{1}{4}$	$4\frac{1}{2}$	48	3	$\frac{1}{2}$	$\frac{1}{8}$	75 0
M	7†	$\frac{1}{4}$	$3\frac{1}{8}$	3	3	$\frac{1}{2}$	$\frac{1}{8}$	5.62
N	7	$\frac{1}{4}$	$3\frac{1}{8}$	3	3	$\frac{1}{2}$	$\frac{1}{8}$	5.62
F	4	$\frac{1}{4}$	$4\frac{1}{2}$	4	$2\frac{5}{8}$	$\frac{1}{2}$	$\frac{1}{8}$	5.0

* Twenty-four pockets are 3 inches and 16 pockets are $2\frac{5}{8}$ inches.

† The number for type M indicates the number of positive tubes in the battery instead of the number of positive plates.

Assembly

The necessary number of plates of each kind for any particular size of cell are mounted on steel rods which pass through the eyes of the grids at the top of the plates. The plates are separated from one another by means of washers fitting on this rod and are locked in place by a lock washer and nut on the end of the rod. Groups of positive and negative plates, corresponding to the positive and negative groups of the lead storage batteries, are assembled in this way. The rod which supports the positive or negative plates and connects them electrically is called the "connecting rod." The groups of positive and negative plates are intermeshed to form the element, and the plates of opposite polarity are separated by hard rubber pins. Side sepa-

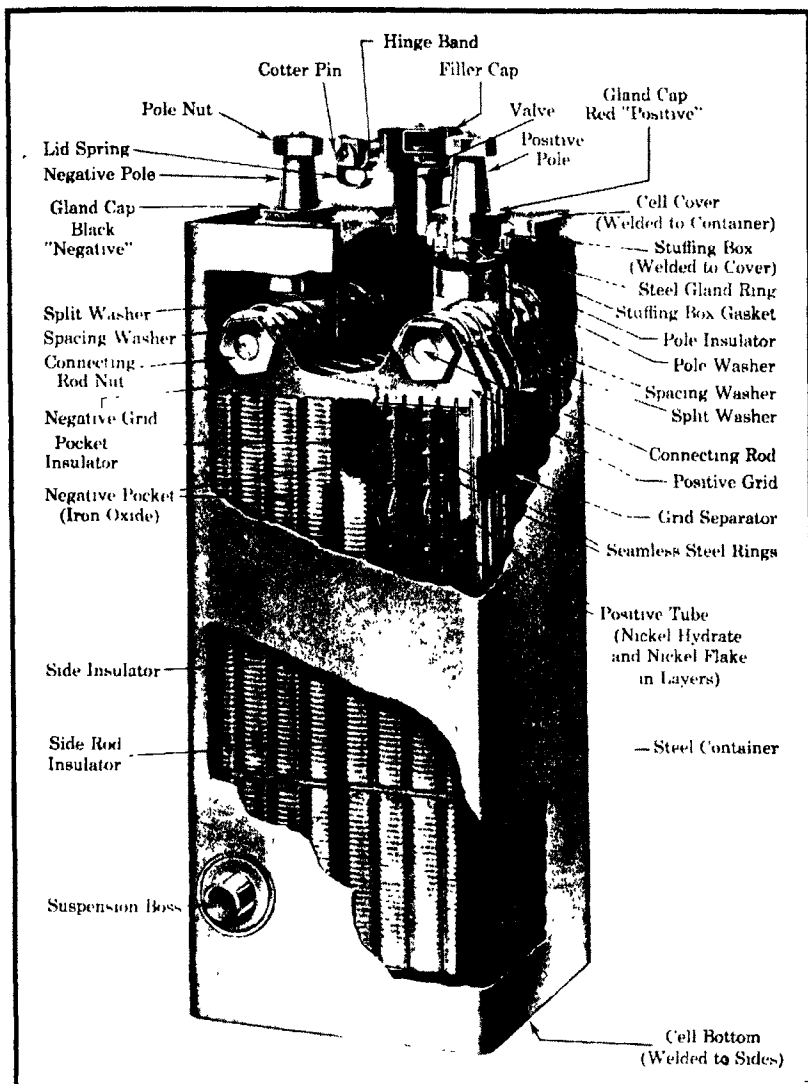


Fig. 40. The Edison cell, nickel-iron or alkaline type of storage cell.

rators, consisting of flat sheets of hard rubber, are used around the outside of the element to insulate it from the walls of the container. The element, when completely assembled, is slipped into the containing jar or can and rests upon a bridgework of hard rubber at the bottom. A complete cell is shown in Fig. 40. The can is made from sheet steel, nickel-plated. The newer cells are without corrugations as

Storage Batteries

thicker metal provides the necessary strength. The metal is bent into shape around a form, and the side seams are welded by an oxyacetylene flame. The bottom of the cell is welded to the sides of the can, and after the element is in place the top seams are welded also. The container parts, such as cover, sides, and bottom, are nickel-plated before welding and after welding also. The terminal posts for the plate groups pass through openings in the top of the cell and are sealed into

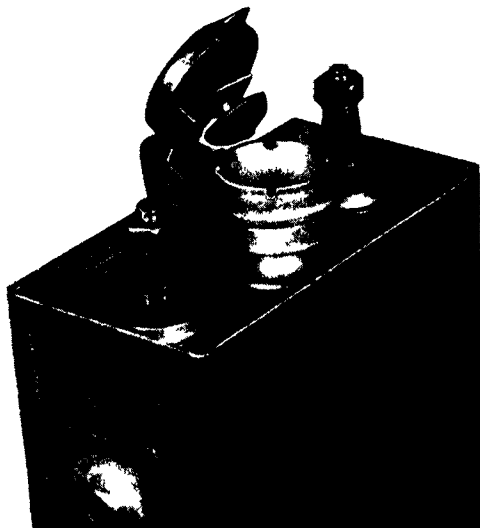


Fig. 41. Gas valve and vent on the Edison cell.

place by a combination of hard- and soft-rubber gaskets and bushings. The bushing around the positive pole is red, while that around the negative pole is black. In this way a clear indication of the polarity of the cell is given. In the center of the cover is a combination valve and filler (Fig. 41). This consists of a hemispherical valve equipped with a spring that permits the valve to be opened for filling the cell with electrolyte or water but normally presses the valve against the seat. As the pressure of gas in the cell rises when it is on charge, the valve is displaced, allowing the gas to escape. This gives rise to the familiar popping sound which is often heard when batteries of this type are being charged. The satisfactory operation of the cell depends in considerable measure upon the gas valve, since the electrolyte, potassium hydroxide, has a strong tendency to absorb the carbon dioxide from the air. The valves may be easily opened, however, for filling the cells with water.

The terminal posts for the cells are of steel, tapered and ground to fit the lugs of the intercell or intertray connectors. The top of the post is threaded to take a lock nut. The lugs of the intercell connectors are drop forgings of steel, bored, reamed, and ground to fit the taper of the terminal posts. Both the terminal posts and the lugs are finished by nickel-plating and annealing in an atmosphere of hydrogen. This prevents the corrosion of the steel and provides a satisfactory contact surface in spite of the thin oxide film that exists on the nickel surfaces. The connecting links are copper swaged into the lugs, and the whole is nickel-plated. The lugs may easily be removed from the terminal posts by the use of a wrench and jack; these tools are necessary because the lug generally becomes "frozen" to the posts.

Electrolyte

The electrolyte for the alkaline cells is a solution of potassium hydroxide in water. For the Edison cells a small amount of lithium hydroxide is added because of its beneficial effect on the capacity of the cells. As a substitute for the potassium hydroxide, an electrolyte of sodium hydroxide has been tried, but the physical properties of this solution are not as good for the purpose as those of the potassium solution. The preparation of the electrolyte and the physical properties of it are described in Chapter 3.

Trays

The cells are usually mounted in trays which have open sides and in most cases are bottomless. Some of the larger locomotive batteries are now available in steel cradles or steel boxes. The cells are supported in these trays by bosses (Fig. 42) on the sides of the cans of the individual cells. The bosses fit into rubber buttons in the sides of the tray. These supports serve also to separate and insulate the cells, which is quite necessary because the containers for these cells are metallic conductors. The outside surface of the cells is coated with an insulating paint, and a film of rosin or liquid "Esbaline" is used to protect the top.

Types and Sizes of Edison Plates

The sizes of the Edison batteries are described in Chapter 10 in connection with the discussion of applications which are made of them. In this place, however, will be given a table analogous to that which has been given for the lead batteries, showing the different types of plates for Edison storage batteries, the number of tubes and pockets that they contain, with dimensions, and the nominal capacity of these

plates at the normal rate of discharge. The nomenclature for the Edison cells is simple. The type of cell is designated by a letter followed by a number. The letter indicates the type of plate which the cell contains, and the number indicates the number of positive plates. An exception is made for the smaller sizes of the Edison batteries; for

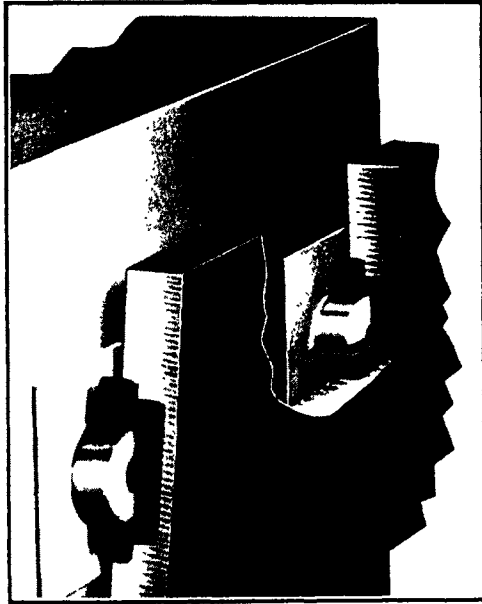


Fig. 42. Method of supporting Edison cells in the tray.

these the number indicates the number of positive tubes instead of the number of positive plates.

The standard plate for the Edison battery is called the A plate. This is designed for general purposes, electric vehicles, trucks, locomotives, isolated farm lighting plants, and railway train lighting. The next most common plate is known as the B plate. It is used for lighting service, ignition, fire- and burglar-alarm systems, and clocks. B plates have half the capacity of A plates. C plates are equal to an A plate plus a B plate. D plates have double the capacity of A plates. The M and N types contain positive tubes $3\frac{1}{8}$ inches long and seven tubes to the plate. These are small plates designed for use with mine lamps, clock circuits, and time recorders. In addition to the types named above, there is also the F plate, used in mine-lamp batteries.

Some types of cells are designated by additional letters H or HW. These signify variations in the container: A6H is an A6 cell in a

container that has extra height, and A6HW has extra height and width. The additional space allows more electrolyte to be used so that flushing is required less often.

NICKEL-CADMIUM CELLS (ALKALINE TYPE)

Although nickel-cadmium cells were little known in this country until recently, their production in Europe increased greatly after 1930. They are used for emergency lighting, control and switch-gear operation, marine services, railroad signaling, Diesel starting, and auxiliary power systems. Cadmium is said to be less subject to self discharge than iron and is relatively free from passivity at low temperatures. The average voltage of a cell on discharge is about 1.2 volts.

Nickel-cadmium cells now are known in two distinct forms. The older is the Jungner type of cell developed first in Sweden about 1900, and the other is an impregnated sintered-plate type which apparently originated in Germany during World War II. Both are now being made in this country. The sintered-plate type at the present time is used more for military purposes than the Jungner type.

The Jungner Type of Cell

The positive and negative plates are usually similar in construction, consisting of perforated pockets which contain the active materials. However, the positive plates in some European types of nickel-cadmium cells are of tubular construction and resemble closely those found in Edison cells. The pockets for both positive and negative plates are made from perforated steel ribbon which has been nickel-plated and annealed in hydrogen. Provision must be made for some expansion of the positive active materials within the pockets. Progressive swelling of positive plates in American-made "Nicaid" batteries was corrected by the use of nickelic (black) hydroxide instead of the nickelous hydroxide (green) as the filling for the pockets. To that is added highly purified natural graphite to increase the conductivity.

Pockets of the negative plates are filled initially with cadmium oxide, CdO , or cadmium hydroxide, $\text{Cd}(\text{OH})_2$, either of which is reduced to metallic cadmium in a spongy form on the first charge. Most manufacturers of these cells add iron (5 to 30 per cent) to the cadmium in order to obtain the required degree of fineness of the cadmium. The beneficial effect of the iron seems to be a more or less empirically determined fact, and the real function of the iron is not entirely clear. Some have thought that it forms an alloy with the cadmium; others have regarded it as an expander; and still others

FORM 274

TRADE MARK
Thomas A. Edison

The Edison Portland Cement Co.

THOMAS A. EDISON, CHAIRMAN OF BOARD
 HENRY H. THOMPSON, PRESIDENT
 W. S. MALLORY, VICE-PRESIDENT
 WILLIAM F. HEND, SECRETARY
 H. F. MILLER, TREASURER

Telegraph, Freight and Passenger Station, NEW VILLAGE, N. J.

P. O. ADDRESS, STEWARTSVILLE, N. J.

SALES OFFICES:
 PHILADELPHIA, PA., Arcade Building
 NEW YORK, N. Y., St. James Building
 PITTSBURGH, PA., Machinery Building
 NEWARK, N. J., Union Building
 BOSTON, MASS., Post Office Square Bldg
 SAVANNAH, GA., National Bank Building

Dear Mr. Edison:

Harry - find out what was paid for property at 1st cost of additional building & firming up

October 19, 1906.

During the excursion on Oct. 10th one of the party asked me what you intended to do with the property and plant at Glen Ridge and I told him that ^{while} so far as I knew there was no immediate use for it, that we have several plans under consideration and I believed that we would soon be able to start it up. He then told me that some of the local people would like to purchase it if the cost was not too great, and the enclosed letter is undoubtedly the result of that conversation. I would be glad if you would let me know at what price you would sell the property, and what cash payment you would require and the amount of the mortgage and rate of interest.

The gentleman who was talking to me intimated that if a fair figure could be had on the property that some of the local people would chip in and buy it, so to get rid of manufacturing in Glen Ridge.

Yours very truly,

W. S. Mallory

WM-MBS

ENCLOS:

000423

TAE00081

OFFICE OF THE
MAYOR AND COUNCIL
BOROUGH OF GLEN RIDGE
STATE OF NEW JERSEY.

52 Broadway, New York City,
GLEN RIDGE, N. J., Dec. 20, 1912. 191

Ans Mr

Thos. A. Edison, Esq.,

Orange, N.J.

Dear Sir:-

Some time in the latter part of June I wrote you in answer to your favor of June 8th, regarding the property you own on Bloomfield Ave., running through to Belleville Ave., Glen Ridge, N.J.; giving you at that time a memorandum of the valuation as placed thereon by one Howard B. Davis of Bloomfield.

What I should like to know, if agreeable to you ^{is} if you would care to sell a part or the whole of this property, and what figures you place upon the same. I have no desire to get your figures other than for the purpose, if a purchase could be made, for the use of this land for Fire Dept. and Police Department purposes.

Yours very truly,

Robert Root

Chairman of Fire Committee.

TR/CF

000524

TAE00095

OFFICE OF THE
MAYOR AND COUNCIL
BOROUGH OF GLEN RIDGE
STATE OF NEW JERSEY.

52 Broadway, New York City,
GLEN RIDGE, N. J. June 9, 1913. 191

Thos. A. Edison, Esq.,

Orange, N. J.

Dear Sir:-

*We are still holding it
for storage*

On December 24th, 1912, you wrote to me in
reply to a former letter of mine as to the Glen Ridge property;
that you were holding this property for storage purposes
until such time as you might finish certain buildings at
Orange that you were erecting.

As it is nearly six months since then, I thought
I would drop you a line asking what the conditions were at
this time.

Yours very truly,

Albert Port.

TR/CF

Chairman of Fire Committee.



000619

No. 723,449.

PATENTED MAR. 24, 1903.

T. A. EDISON.
ELECTRODE FOR STORAGE BATTERIES.

APPLICATION FILED NOV. 28, 1902.

NO MODEL.

3 SHEETS—SHEET 1.

Fig. 1

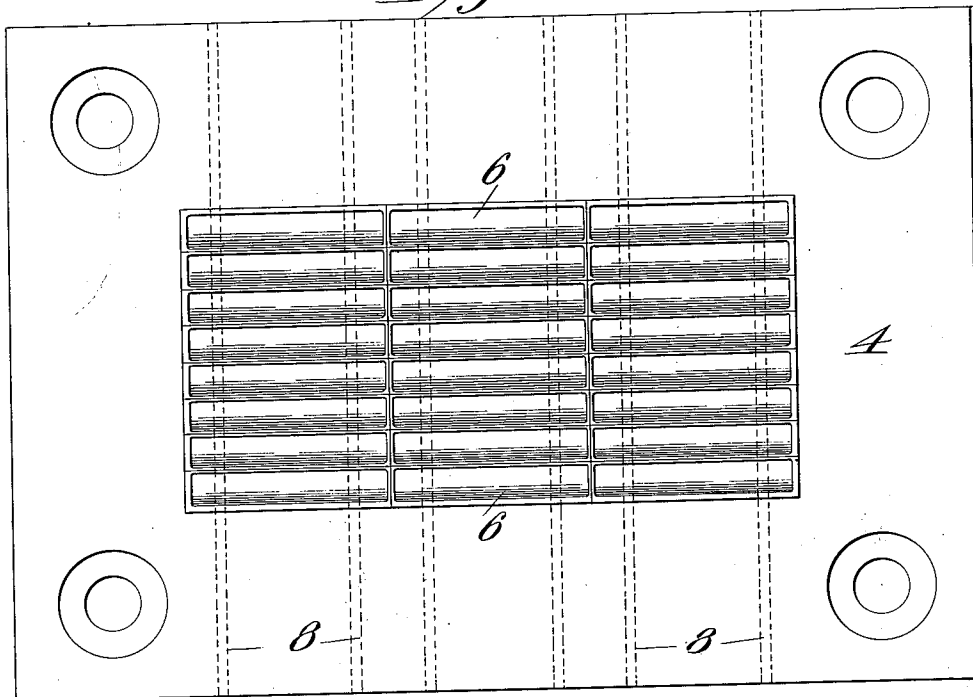
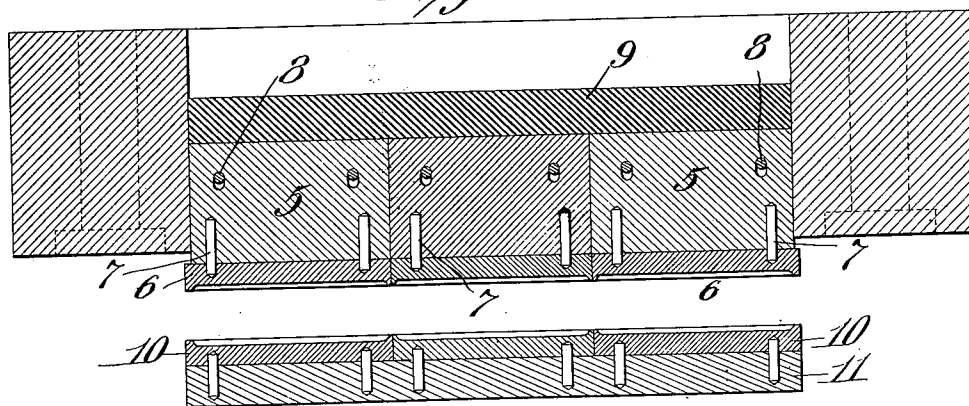
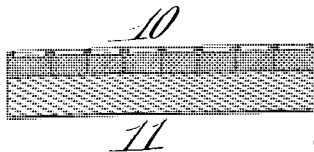


Fig. 2



Witnesses: *Fig. 3*
Jas. F. Coleman
Geo. Robt Taylor



Inventor
Thomas A. Edison
by *Ripen Edmund & Son*
Attorneys

No. 723,449.

PATENTED MAR. 24, 1903.

T. A. EDISON.
ELECTRODE FOR STORAGE BATTERIES.

APPLICATION FILED NOV. 28, 1902.

NO MODEL.

3 SHEETS—SHEET 2.

Fig. 4

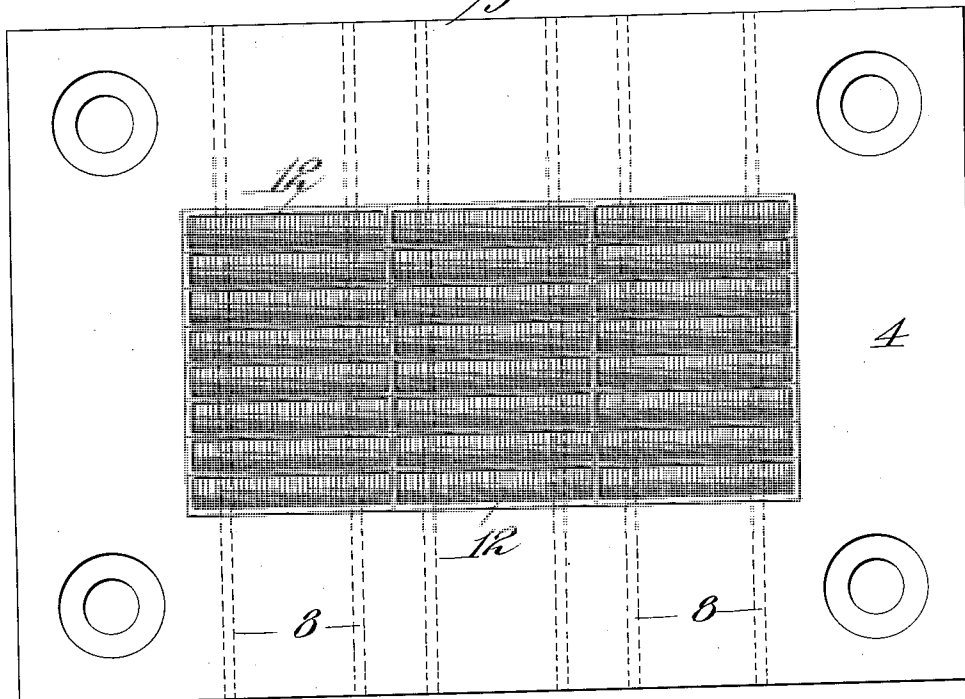


Fig. 5

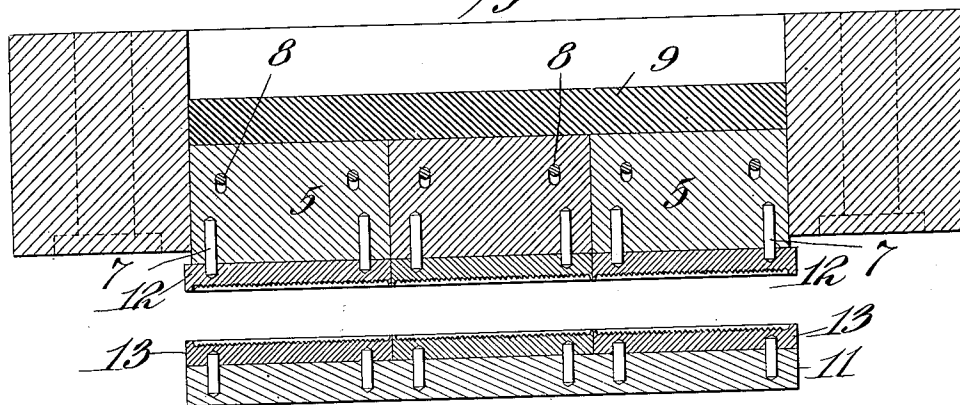
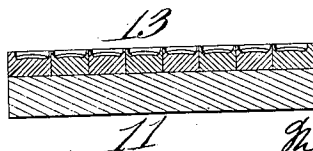


Fig. 6



Witnesses: *Jas. F. Coleman*
Geo. Robt Taylor

Inventor
Thomas A. Edison
by *Alfred Edmund Soper*
Attorneys

No. 723,449.

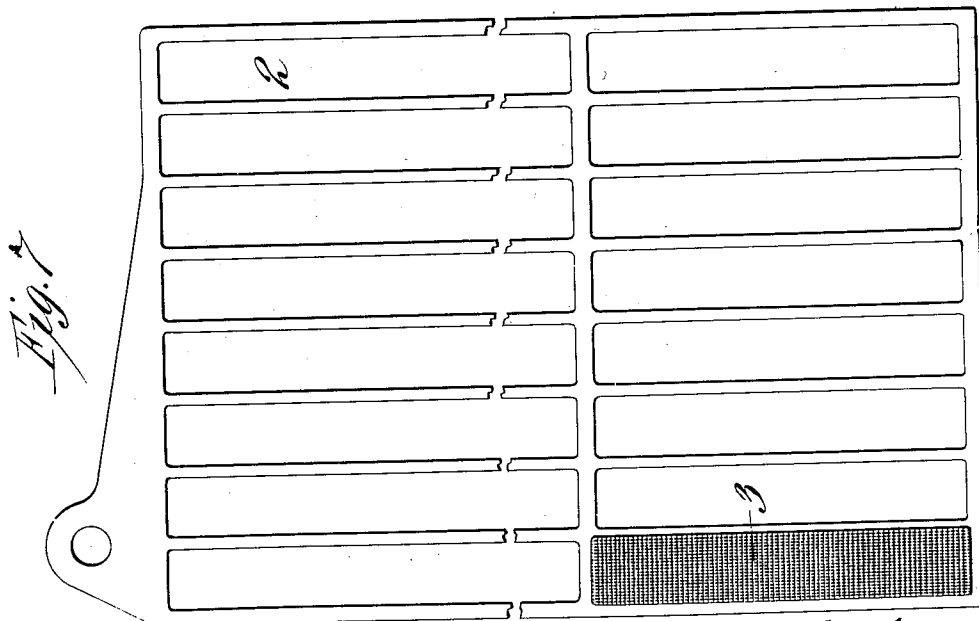
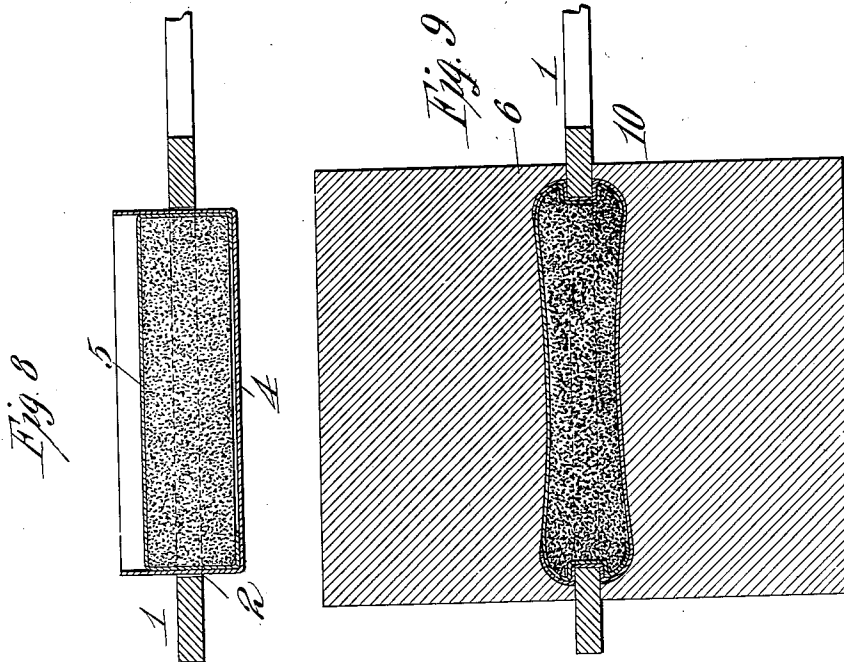
PATENTED MAR. 24, 1903.

T. A. EDISON.
ELECTRODE FOR STORAGE BATTERIES.

APPLICATION FILED NOV. 28, 1902.

3 SHEETS—SHEET 3.

NO MODEL.



Witnesses:

Geo. F. Coleman
Wm. Robt Taylor

Inventor

Thomas A Edison

By *Wm. Coleman & Co*
Attorneys

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

ELECTRODE FOR STORAGE BATTERIES.

SPECIFICATION forming part of Letters Patent No. 723,449, dated March 24, 1903.

Application filed November 28, 1902. Serial No. 133,115. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Electrodes for Storage Batteries, of which the following is a specification.

My invention relates to storage batteries of the type invented by me, and wherein an alkaline electrolyte is employed with insoluble active materials. The preferable material used for depolarizing purposes is an electrolytically-active oxid of nickel, and that for the oxidizable element on discharge is electrolytically-active iron or compound thereof. These active materials are supported in position within sheet-metal nickel-plated perforated corrugated pockets or receptacles crimped in position within openings formed in suitable plates or grids. I have found in practice, and especially so in connection with the nickel element, that the active material when immersed in the electrolyte and subjected to a charging-current tends to objectionably bulge at the center, so that the plates cannot be placed sufficiently close to each other, as is desirable where weight of electrolyte is sought to be reduced. I have found that by concaving the pockets or receptacles when the electrode is first assembled the swelling of the active material does not objectionably bulge the latter, whereby I am enabled to overcome the objection noted, and it is to this feature that the invention principally relates. I have also found that the best results are secured in practice when the manufacture follows a definite line of procedure, and this process constitutes the second part of my invention.

In order that my invention may be better understood, attention is directed to the accompanying drawings, forming part of this specification, and in which—

Figure 1 is a plan view of a set of independently-mounted smooth concaving-dies; Fig. 2, a sectional view through the same and illustrating also the opposing set of solidly-mounted concaving-dies; Fig. 3, a cross-sectional view through the latter dies; Figs. 4, 5, and 6 views corresponding to Figs. 1, 2, and 3, illustrating the corrugating-dies;

Fig. 7, a plan view of one of the grids, showing a single pocket or receptacle in position therein; Fig. 8, a cross-sectional view, on an enlarged scale, showing the two parts of one of the pockets introduced in position within one of the openings in the grid; and Fig. 9, a corresponding view on the same scale, showing the smooth dies for effecting a crimping of the pockets and for also concaving the same.

In all the above views corresponding parts are represented by the same numerals of reference.

1 represents the grid or plate, made of iron or steel, carefully nickel-plated and formed with openings 2 therein, and 3 represents one of the sheet-metal nickel-plated corrugated pockets or receptacles crimped into position in one of the openings. Each of these pockets or receptacles is composed of two cup-shaped parts 4 and 5, the former receiving the latter. The briquet is first introduced into the part 5 and the edges are turned down underneath the briquet, so as to firmly lock the briquet in the part 5. (See Fig. 8.) The part 5, carrying the briquet, is then introduced into the part 4, so that when a crimping pressure is applied to both parts the part 5 will be locked within the part 4, and the pocket or receptacle as a whole will be crimped around the edges of the opening in which it is introduced, so as to be firmly locked in place therein. By turning the edges of the part 5 around the briquet, as explained, the briquet will be held more rigidly in position than when it is merely introduced into the part 5, as I have described in previous patents. As shown in Fig. 9, the pockets or receptacles are concaved longitudinally, so that when any swelling of the active material takes place it will not objectionably bulge the pockets. This inward concaving or arching of the pockets also strengthens them somewhat to resist bulging strains, as will be obvious. The concaving and crimping of the pockets in place are effected by means of dies, which apply pressure to all the pockets of a single plate, so that a complete electrode will be formed by a single compressing operation. I find, however, in practice that the best results are secured in the manufacture of corrugated pockets when two sets of dies are employed, one for effect-

ing the crimping and concaving of the pockets and the other for effecting the corrugating thereof, since in this way the application of the first pressure tends to evenly distribute the active material within the pockets. If, on the contrary, the concaving, crimping, and corrugating of the pockets were effected at a single operation, I have found that the active material is not satisfactorily distributed throughout the several pockets. I preferably therefore employ two sets of dies, one set being shown in Figs. 1, 2, and 3, and the other set being shown in Figs. 4, 5, and 6. Referring to the first set, 4 represents a heavy frame carried by the movable member of a hydraulic or other powerful press. Mounted in this frame are a number of blocks 5, each carrying a die 6, secured to the blocks by means of pins 7. The blocks 5 are capable of independent movement with respect to each other and with respect to the frame 2 by being strung on pins 8, engaging slotted openings in said blocks. Behind the blocks is a layer of rubber 9 or other suitable yielding but non-compressible material, whereby any one of the dies 6 is capable of moving independently of the other dies. Coöperating with the dies 6 are corresponding dies 10, carried by a plate 11, secured to the stationary member of the press. As shown in Fig. 3, the dies 6 and 10 are provided with smooth convex surfaces. It will be obvious that by assembling the two parts, 4 and 5, of each receptacle in the several pockets of the plate and by first introducing a briquet of the active material in said pockets the application of pressure to the frame 4 will cause the dies 6 and 10 to force the parts 4 and 5 of each pocket together to lock the part 5 within the part 4 to crimp the pocket or receptacle as a whole around the edges of the corresponding opening and to concave the longitudinal faces of each pocket. This application of smooth concaving-dies effects an even distribution of the active material throughout each of the pockets.

The dies shown in Figs. 4, 5, and 6 are identical with those previously described, except that the dies 12 and 13 (corresponding to the dies 6 and 10, respectively,) are provided with transverse corrugations, as shown in Fig. 6. When the pockets or receptacles have been concaved and crimped in position within the grid or plate, the latter is placed between the dies 12 and 13 and pressure applied, whereby the pockets or receptacles will be transversely corrugated, as I have described in patents already granted. By thus transversely corrugating the exposed surfaces of the pockets or receptacles the strength of the latter is very materially increased, permitting the employment of lighter sheet metal.

The purpose of mounting the dies 6 and 12 so that they shall be capable of independent movement is to accommodate variations in the amount of active material in the several

pockets and inevitable in a manufacturing operation carried out on a large scale.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle secured in said opening and having a concaved surface, and an active material in said pocket or receptacle, substantially as set forth.

2. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle secured in said opening and having concaved surfaces, and an active material in said pocket or receptacle, substantially as set forth.

3. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle secured in said opening and having a concaved corrugated surface, and an active material in said pocket or receptacle, substantially as set forth.

4. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle secured in said opening and having concaved corrugated surfaces, and an active material in said pocket or receptacle, substantially as set forth.

5. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle having a concaved surface and crimped in position within said opening, and an active material in said pocket or receptacle, substantially as set forth.

6. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle made of two parts, crimped in position within the opening and having a concaved surface, and an active material in said pocket or receptacle, substantially as set forth.

7. A battery-electrode, comprising a plate having a plurality of openings therein, a pocket or receptacle in each opening having a concaved surface, and an active material in said pocket or receptacle, substantially as set forth.

8. A battery-electrode, comprising a plate having a plurality of openings therein, a pocket or receptacle in each opening having concaved surfaces, and an active material in said pocket or receptacle, substantially as set forth.

9. A battery-electrode, comprising a plate having a plurality of openings therein, a pocket or receptacle crimped in position in each opening and having a concaved surface, and an active material in said pocket or receptacle, substantially as set forth.

10. A battery-electrode, comprising a plate having an opening therein, a pocket or receptacle secured in said opening and of less thickness along its longitudinal center than at the sides, and an active material in said pocket or receptacle, substantially as set forth.

11. A battery-electrode, comprising a plate having an opening therein and a pocket or receptacle containing a briquet of active ma-

723,449

3

terial and secured in said opening, the pocket
or receptacle being formed of two cup-shaped
parts received one within the other, one of
the parts having turned-over edges to lock the
5 briquet therein, and being in turn locked
within the other part by turned-over edges,
as and for the purposes set forth.

10 12. A battery-electrode, comprising a plate
having an opening therein and a pocket or re-
ceptacle containing a briquet of active ma-
terial and secured in said opening, the pocket
or receptacle being formed of two cup-shaped
parts received one within the other, one of

the parts having turned-over edges to lock the
briquet therein and being in turn locked 15
within the other part by turned-over edges,
and the exposed surfaces of the pocket or re-
ceptacle being concaved, as and for the pur-
poses set forth.

This specification signed and witnessed this 20
13th day of November, 1902.

THOS. A. EDISON.

Witnesses:

FRANK L. DYER,
J. F. RANDOLPH.

J. D. GADSDEN, PRESIDENT
CLARENCE PLACE, SECRETARY
J. F. PLACE, CONSULTING ENGINEER

OPERATING THE PLACE ATMOSPHERIC OXYGEN
PATENTS FOR MECHANICAL LIQUEFACTION
AND DISTILLATION OF AIR

2309
TELEPHONE:
3009 CORTLANDT

*I am at present using it for Storage
I would not like to rent, I saw an empty factory
near Canal 1/2 mile or so west of*

AMERICAN AIR-LIQUEFYING CO.

WASHINGTON LIFE BUILDING

141 BROADWAY

Mr. Thomas A. Edison
Orange, N.J.

Hendricks Coffee Mill that might suit you

NEW YORK,

April 23, 1915.

Dear Sir:

I received your favor of the 15th inst. In reply I will say:

I live in Glen Ridge, and have lived there for 25 years. I probably know more about what the Borough want to do or will do than you do. I know one thing, they will buy no land with buildings on it, unless the seller agrees to remove the same at once. Your land is assessed at \$7,000. and your buildings at \$20,000. According to that, if you sell to the Borough, three-fourths of the value of the property would have to be sacrificed—as every brick would have to be carted off the lot, before they would even agree to buy it or lease it.

You do not say what you will rent the building on Belleville Avenue for, or whether you wish to rent it at all.

Very truly yours,

J. F. Place

JFP/G

000456

TAE00156

EDISON STORAGE BATTERY COMPANY RECORDS

The Edison Storage Battery Co. (ESBCo) was organized in New Jersey on May 27, 1901, in order to develop, manufacture, and sell Edison's alkaline storage battery. Edison served as the company's first president, Walter S. Mallory, as vice president, and John F. Randolph, as secretary and treasurer. The company was initially capitalized at one million dollars. The capitalization was increased to \$3.5 million in 1910 and to \$5 million in 1917, largely to reduce the company's indebtedness to Edison, who financed much of the battery research. Commercial manufacture of a nickel-iron battery began in January 1903 but was suspended on November 1, 1904, when the "E" cells suffered reduced electrical capacity and leakage. After technical improvements to the production process and to the battery itself, beginning with the "A" cell, commercial manufacture resumed in 1909.

Chemicals for the batteries were manufactured in Silver Lake, New Jersey, and the batteries themselves were assembled nearby, first in Glen Ridge and later in West Orange. Despite increased orders and production, the company did not realize a net profit until 1913, due largely to its research budget and indebtedness. Research and development were performed by ESBCo's own Research Department, as well as at Edison's laboratory in West Orange. Product lines and sales structures were expanded throughout the company's history. Batteries were manufactured for mining lamps, train lighting and signaling, submarines, electric vehicles, and other uses. ESBCo had its own sales force, but it also sold batteries through separate sales companies, including one Edison company—the Edison Storage Battery Supply Co. (formed in 1913)—and non-Edison companies such as Miller Reese Hutchison, Inc. (formed in 1916). Foreign sales rights were controlled at different times by various agents, including Herman E. Dick, Paul H. Cromelin, Maurice E. Fox, and John F. Monnot. After Edison's death the company was merged into Thomas A. Edison, Inc.

The records are arranged in four series: (1) Administrative Records; (2) Financial Records; (3) Plant Operations and Research Records; and (4) Sales Records. A finding aid for the archival record group is available at the Edison National Historic Site. Related documents can be found in the Notebook Series, Document File Series, and Richard W. Kellow and Harry F. Miller files in the Legal Series.

0 0 0 1 5 7

Administrative Records. These records consist of incoming and outgoing correspondence, memoranda, agreements, and other material pertaining to the administration of ESBCo. The selected records are arranged in the following order: (1) correspondence (1901-1931); (2) corporate documentation (1901-1924); and (3) letterbook (1904-1916). Among the items not selected are the minutes of the Executive Committee meetings for the period 1916-1918.

Financial Records. These records consist of bound ledgers and journals and unbound statements. The selected records are arranged in the following order: (1) annual statements (1911-1916); (2) general ledgers (1901-1917); and (3) journals (1901-1917). Among the items not selected are two journals (1920-1921); a journal of the Edison Storage Battery Garage, Inc. (1919-1926); a cash book pertaining to the Darby Mine (1905-1907); and numerous monthly statements.

Plant Operations and Research Records. These records consist of unbound and bound material relating to plant operations at ESBCo factories and to research and development done on behalf of ESBCo by its own Research Department and by Edison's West Orange laboratory. The selected items are arranged in the following order: (1) operations reports (1905-1924); (2) research reports (1901, 1914-1923); and (3) research notebook (1901-1903). Among the items not selected are an unfilled orders notebook (ca. 1901-1902); eight receiving books (1901-1916); an automobile test book (1902); five payroll abstract books (1911-1917); six plant operations log books (1920-1921); and graphs showing the performance of batteries used in automotive starters (1922-1930).

Sales Records. These records consist of reports, correspondence, and printed material pertaining to the sales organization of ESBCo. The documents relate to the salesmen and operations of ESBCo as well as to relations with the Edison Storage Battery Supply Co. and Miller Reese Hutchison, Inc. The selected items are arranged in the following order: (1) daily and monthly sales reports (1910-1924); and (2) documents relative to the business of Miller Reese Hutchison, Inc. (1911, 1916-1918). Among the items not selected are a scrapbook of advertisements and promotional articles (1912-1914) and two in-house publications—*Storage Battery Transportation* and *Storage Battery Power* (1928-1958).

0 0 0 1 5 8