Electricity in the Shoe and Leather Industries

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Electricity in the Shoe and Leather Industries

A Thesis

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by

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INTRODUCTORY

To the industrial world the use of electricity as motive power is now almost indispensable and the mechanically operated factory will in a few years be as antiquated as the factory which today operates without modern power driven machinery. In no class of industries is this economical and tractible form of power more easily adapted than in the shoe and leather industries comprising shoe factories and tanneries.

As an indication of the extent to which electricity has been adapted to the operation of shoe machinery it is interesting to note that according to an unofficial canvass approximately 200 establishments out of a total of about 500 factories located in New England have made use of electricity as a motive power.

It is the experience of the writer that industrial establishments have a tendency to install electrical equipments solely with view to minimizing the initial expense. For this reason many electrically driven plants are to be found which do not take full advantage of the flexibility of electric power. These plants are frequently as susceptible to improvement as the mechanically driven plant. The manufacturer who contemplates the construction of an electrically driven factory or the change over of an old establishment from mechanical to electric drive should, for these reasons, employ an engineer who is familiar with the numerous advantages of electric drive rather than to rely on the mechanic who is familiar only with the older methods.

In tanning establishments it is even more essential to employ electric drive than in shoe factories since the plant
usually contains several buildings spread over a large area and the quantity of energy required is many times greater. Before the advent of electric drive the problem was very unsatisfactorily solved by the installation of several isolated steam plants at or near the points requiring power. This arrangement is still used in some parts of the country but the expense of operation is such that tanneries are rapidly being compelled by competition with up-to-date manufacturers to change over to more modern methods. When figured in dollars and cents the expense of maintaining and operating a distributed power system of this kind is appalling. Each engine and boiler must have one or more attendants and each on account of its size and intermittent load is enormously wasteful in the use of fuel.

The application of electricity allows the concentration of generating equipment at one point and a corresponding reduction in the attendance. The power requirements are collectively more uniform and therefore allow the engine and boilers to work at higher efficiency.

The various illustrations include both good and indifferent examples of motor application but in the main are typical of the methods ordinarily employed in the shoe factories and tanneries of the United States.

It is intended in this thesis to enumerate the reasons for advocating electric drive for shoe factories and tanneries, to indicate by description and photographs the most economical and approved methods, and to include by way of illustration
detailed description of a number of typical up-to-date installations which have been investigated with this end in view.

To insure a logical presentation of the subject the order of the discussion will be as follows:

I Boot and Shoe Factories

(a) General argument and statistics
(b) Advantages of Electric Drive
(c) Power Supply
(d) Alternating or Direct Current
(e) Specific Applications
(f) Typical Installations

II Tanneries

(a) General
(b) Advantages of Electric Drive
(c) Group and individually driven machines
(d) Specific Applications
(e) Installations
Practically all of the boots and shoes purchased in United States are manufactured in this country, and in addition to these, large numbers are exported every year. Government statistics for 1909 place the annual output of about 1900 factories at 247,600,000 pairs.

The narrow margin of profit which is commonly realized by manufacturers of boots and shoes has compelled a careful scrutiny of every item of operating expense in order to reduce the manufacturing cost to a minimum. One of the factors which has recently received considerable attention is the method of driving the machinery employed for various processes of manufacture. Up to a few years ago steam power was employed almost universally for shoe factory drives with transmission by means of belts and shafting. Recent installations, however, have successfully employed the electric motor as driving power for all machinery. The application of electric power to the driving of shoe machinery has proved advantageous not only in the direct reduction of power cost, but also in the increased production for a given factory equipment.

Numerous mechanical improvements have been made in the shoe making tools and more especially in power machinery. Out of from 75 to 100 operations which are performed on each pair of shoes about 70% are now performed by machine. This machinery is of necessity small power apparatus requiring, for example, on the large sole cutting machines, a maximum of 2 1/2 h.p., and on many of the small machines less than 1/10 th of a h.p. for full
operation. The power requirements on these machines are almost without exception intermittent and group drive is employed as the most economical method of operation.

Advantages of Electric Drive

The advantages of electrically operated shoe machinery may be briefly enumerated as follows:

- Economical power transmission
- Uninterrupted service
- Flexibility
- Uniform Speed
- Elimination of \( \frac{1}{2} \) turn belts, mill stand drives, etc.
- Improved natural lighting facilities

The unquestioned superiority of the electrical transmission of energy as compared with mechanical methods is so generally acknowledged that it is quite generally employed when the prime mover is located at any appreciable distance from the driven machines. It is now possible by means of electric motors to operate a plant containing several buildings from a single generating station, at a power cost far below that of mechanically driven plants.

It is also a simple matter to segregate the power costs for various departments and thereby locate and eliminate unnecessary losses.

The reliability of the electric motor and especially of the polyphase induction type is sufficient to insure uninterrupted service with attendance limited to an occasional inspection and oiling. With central station supply or with duplicate generating equipment a complete shut down is almost
impossible.

The flexibility of motor drive allows for extensions or additions to manufacturing equipment without interrupting the operation of the existing equipment. This feature of electrically operated factories is also responsible for the elimination of the inefficient and cumbersome "mill stand drives", quarter turn belts and other contrivances for interconnecting line shafts running at right angles to each other. By use of a separate motor for each line shaft the available power is applied with minimum loss directly to the point required. This arrangement also permits economical overtime operation of individual parts of the factory.

Speed regulation is an important factor in driving shoe machinery since all machines must be operated at the highest speed possible in order to obtain maximum production. By arranging the machinery in small groups and thus eliminating the fluctuation in speed, which is unavoidable with transmission by belts and shafting, a practically constant speed is maintained. On edge trimmers and similar machines uniform speed is of vital importance since too high a rate of cutting will burn the leather while varying conditions produce imperfect work.

In the past very little attention has been given to the methods of supplying power to shoe factories. As long as the engine has continued to furnish the necessary power, the equipment has been considered perfectly satisfactory. In almost every case the matter of efficiency has been entirely overlooked.
and many instances have been found where the major portion of the power generated was used in overcoming friction when by application of the electric motor this loss could have been materially reduced. The cost of power as generated by steam plants in quantities suitable for the ordinary shoe factory and where the coal used as fuel costs from $4. to $5. per ton, is usually from $60. to $75. per horse power per year. For purposes of illustration, a plant requires 100 horse power for a 10 hr. day; the average cost is $50. per horse power year, an annual expenditure of $5,000., at least 20% of this cost could be saved by the installation of an up-to-date electrical equipment. This saving means $1,000. per year and would pay interest on double the investment required to furnish or install a complete modern generating plant. In other words, the electrical equipment including engine, generator, and motors with lighting and the necessary heating devices, would pay for its cost in a comparatively short time. In some cases, dependent upon local conditions, even a greater saving can be made by purchasing Central Station power thus avoiding the cost of installing and maintaining an electric generating plant.

The shoe manufacturer ordinarily spends much valuable time in endeavoring to cut down the cost of raw materials used for manufacturing purposes and feels well repaid when he succeeds in saving a small fraction of a cent per pound on the cost of leather. At the same time he cheerfully pays for the coal which is used in generating his power without even knowing the cost per
TYPE KT 3 H.P. 220 VOLT INDUCTION MOTOR REPLACING "MILLSTAND DRIVE" AND QUARTER TURN BELT DRIVING FINISHING MACHINES ACROSS THE END OF THE ROOM SPRINGVALE SHOE WORKS SPRINGVALE, MF.

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horse power or the amount of power being generated.

With electric drive the exact amount of power being used is registered on the meters, and where Central Station power is used the cost is very nearly proportional to the work done. An accurate record is also available for calculating the cost of energy consumed. Many shoe factories have been using electric power for the past fifteen or twenty years and others have been changed over from mechanical to electric drive with a saving in the cost of power in some cases of from one-half to three-quarters of a cent per pair.

A striking example of excessive friction losses is the use of "millstands" which are practically a necessity in mechanically driven factories. In the average shoe factory a line of shafting is suspended from the floor timbers along the side of the building and driven from the main line shaft. In order to take full advantage of the available floor space and the natural lighting a similar line of shafting is usually required at the end of the building running at right angles to both main and line shafts. In order to make the turn necessary to supply power to this shaft a "mill stand" is usually employed. This contrivance, requires the use of two idler pulleys supported on a vertical shaft and a very tight belt to carry the required load, with the result that considerable power is used simply to operate the belts and shafting.

By the use of an electric motor of the required size belted to each line shaft this loss in transmission is largely eliminated,
and furthermore a uniformly constant speed is insured to the shoe machinery. The belt tightening device which is ordinarily supplied with each motor provides a simple means for keeping the belt at just the proper tension to avoid slipping.

All of the energy consumed by the main, line and counter shafts, and quarter turns with the necessary belts represents wasted power from which absolutely no revenue is derived, and any reduction of this loss means a greater profit in the selling of the finished product.

Another important advantage of the electric motor drive over mechanical methods is the increase of available floor space made possible by the elimination of heavy belting and counter shafts employed to transmit power from one floor to another. It is thus possible to locate the shoe machinery with respect to the natural sequence of operations thus decreasing the length of time required to make each shoe and materially increasing the capacity of a given equipment.

Another annoying and expensive feature of mechanical drives is the liability of accident to the main driving pulley or belt. Not only is the entire working force held up and production delayed but the disabled machinery is earning no return on the investment. Where motors are used an accident to motors or line shafting affects only a small group of machines and comparatively few machines and operatives are made idle. Repairs can also be made with greater facility on account of the lighter equipment.
221292  TYPE KT 5 H.P. 550 VOLT MOTOR DRIVING GOODYEAR STITCHING MACHINES
JOHN H. CROSS AND COMPANY, CAMBRIDGE, MASS.
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Central Station or Isolated Plant Supply

Where central station power can be obtained at reasonable rates it is usually advisable to purchase energy and by this means to save the first cost of generating equipment and the additional expenses of attendance and maintenance. Low rates are usually available on account of the desirable character of the shoe factory load and establishments purchasing a large quantity of power are frequently able to obtain the same rate for power and lighting circuits. In some localities, however, it is impracticable to make use of outside supply and for these cases the steam turbine with alternating current generator furnishes an ideal equipment. This unit is designed to operate at a very high efficiency over a wide range of loads and may be supplied either with or without a direct connected exciter.

Alternating or Direct Current

In the operation of shoe machinery there is no necessity for variation of speed, and for this reason the polyphase induction motor is well adapted to the driving of all machinery. This motor embodies the elements of durability and simplicity in construction, which adapt it to conditions requiring continuous service, with a minimum of attendance. It is designed to carry varying loads at a comparatively high efficiency and is capable of taking care of overloads for short periods. Standard motors are manufactured designed for 25-40 and 60 cycles and all standard voltages.
TYPE KT 2 H.P. 550 VOLT MOTOR DRIVING SEWING MACHINES AND ONE 1 1/2 H.P. MOTOR DRIVING EYELETTING AND BUTTON HOLING MACHINES THROUGH SILENT CHAIN. JOHN H. CROSS AND COMPANY CAMBRIDGE, MASS.

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Where alternating current is not easily supplied and direct current is available the direct current shunt wound motor may be easily adapted to driving all classes of machinery. In case it is desired to make use of storage battery trucks, direct current may be employed for charging purposes by the use of a properly designed rheostat.

Motor Driven Exhausters

From 30 to 40 percent of all power required in shoe factories is used to operate blowers for removing dust, chips and shavings of leather which are collected from the buffing and grinding machines, edge trimmers and similar apparatus. These blowers are ordinarily operated in pairs, preferably by a motor with shaft extended at each end. The load carried by these motors is fairly constant varying with the number of intakes in use. Either alternating or direct current standard motors can be adapted to this work by the use of a special shaft designed to carry a fan at both ends.

Stitching Room Motors

Small motors, 5 h.p. or below, are ordinarily employed for driving sewing machines and correlated apparatus, including eyeleting and button hole stitching machines, small skiving tools, bobbin winders, etc. These are preferably connected to the driving shaft under the work benches by means of short chain drives from 10 to 30 machines being driven from each motor. Since these line shafts operate at about 350 revolutions per minute,
217879  TREEING ROOM.  RICE AND HUTCHINS, SOUTH BRAINTREE, MASS.

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motors designed to operate at 1200 revolutions are employed allowing a speed reduction of approximately 4 to 1. In some cases the motor is suspended from the ceiling below and the chain drive carried through the floor to the line shaft. A neater installation, however, is obtained by locating the motors at the back of the work bench and protecting them by wire screen covers.

Electric Heating Devices

Many small irons and other tools which have been previously heated by gas flame are now giving place to electrically heated appliances. The most popular application at present is the shoe ironing tool which is used in "treeing" or shaping the shoe to the last. The use of an electrically heated iron provides a uniform heat which is essential to the proper treatment of leather. A small rheostat is usually supplied to provide for temperature variation. Embossing dies are also manufactured with electric heating elements, and in some factories the ordinary household flatiron is used for some of the operations.
The plant of Rice and Hutchins located at So. Braintree, Mass. is one of eight establishments operated by this company in various parts of New England. Two large buildings are employed in the manufacture of ladies' and childrens' high grade shoes with a capacity of approximately 9,000 pairs per day. The older of these two buildings was originally driven by a large reciprocating engine through belts and shafting but was some years ago equipped throughout with electric motors.

The new factory was put into operation about two years ago is a brick and concrete structure, 250 feet long by 50 feet wide with four floors and basement. This building was designed for the use of electrically driven machinery and provision was made on each floor for suspending the motors from the ceiling while the small motors in the stitching departments on the 4th floor are located on the back of the work benches.

The engine room contains a 300 kw. General Electric Alternator direct connected to a Harris engine operating at 150 r.p.m. Three phase 60 cycle current is generated at 600 volts and distributed through a five panel switchboard to the various parts of the factory. A 14 kw. commutating pole exciter furnishes exciting current at 125 volts to the revolving field. This generator is belted to the main shaft of the engine.

As may be seen from the illustrations the machinery is driven in small groups, the number of the machines varying with the character of the work. In order to obtain the best light for the work room the machinery is located near the windows, each
217887 300 KW. 150 R.P.M. 600 VOLT THREE-PHASE 60 CYCLE ENGINE-DRIVEN ALTERNATOR WITH BELTED EXCITER. RICE AND HUTCHINS, SOUTH BRAINTREE, MASS.

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line shaft and its group of machinery being operated by a separate motor. In the old factory there are 20 motors with a total rating of 150 h.p., the largest being rated 20 h.p. In the new building 44 motors are employed totaling 200 h.p. The capacity of this new equipment is about 6000 pairs per day. Motors rated 15 and 20 h.p. are employed driving exhausters for the dust collectors, but the largest motors used for driving shoe machinery are of the 10 h.p. size. These motors are all of the three-phase induction type, those above 7 1/2 h.p. being provided with starting compensators and the smaller sizes with oil switches. These switches throw the motor directly on the line and also provide overload and no-voltage protection.

On account of the fact that the operations performed on all of these machines are intermittent, it is difficult to approximate the exact load on each motor. Careful tests are frequently made to determine the average load and the motor is changed when found to be working too far above or below normal capacity. While the individual operations are intermittent, the total obtained by grouping the several machines under one motor is fairly constant; the engine room meters showing comparatively steady load.

Both hand and machine methods are used for cutting the upper leather and cloth into vamps, tops or quarters, and linings. The upper cutting or "clicking machines" are located on the second floor, eleven machines being driven in one group by a 5 h.p. motor. The various parts are classified in the fitting department and sent to the stitching room for assembly of the upper.
This room, which occupies the entire top floor, contains over two hundred stitching, eyeleting and similar light machines operated in groups by twenty 1\frac{1}{2} h.p. motors. A section of the stitching room is shown in Fig. 4, eighteen sewing machines being grouped under one motor while the apparatus on the right comprises button holing and miscellaneous types of machinery. The motor is located on the back of the work benches and connected to the line shaft under the table by a short silent chain. A galvanized iron cover perforated to allow ventilation is fitted over each motor to prevent accidental contact by operatives and to protect the motor from dust and dirt. One of the starting switches may be seen on the left of this picture while the motor on the right is controlled from a switch supported underneath the table.

The sole and heel cutting machines are located in the basement and on the first floor. Material for making up the shoes, including insoles, outsoles and uppers, is taken to the making room where the various operations of pulling over, lasting, nailing and stitching are performed. On this floor there are four 10 h.p. and two 5 h.p. motors driving shoe machinery, while a 20 h.p. motor drives two 60" exhaust fans. These exhaust pipes carry the leather scraps and dust to the large receiver over the engine room where it is used under the boilers as fuel.

In the finishing room the apparatus is driven in three groups by a 10 h.p. and two 5 h.p. motors. This machinery
includes edge trimmers, leveling, treeing and heeling machines and buffing, cleaning and polishing wheels.

A 15 h.p. motor drives two 60" fans near the center of the room for the exhaust system on this floor. There are also three ½ h.p. motors in this department direct connected to brush wheels and a similar motor driving a stamping machine.

In addition to the factory machinery there are several elevators operated by standard induction motors belted to controlling devices.

All of the lighting in these factories is by incandescent lamps supplied by four 30 kw. transformers. Special arrangement is made in the stitching department for adjustable bench lamps for each of the sewing machine operators. Tungsten lamps with holophane reflectors are also installed on the ceiling. Electricity is also used from the lighting circuits for heating shoe ironing tools, embossing dies, etc.
217904 250 KW. 150 R.P.M. 600 VOLT THREE-PHASE 60 CYCLE ENGINE-DRIVEN ALTERNATOR WITH CVC BELTED EXCITER. W. H. McELWAINE COMPANY, NASHUA, N. H.

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THE W. H. MOELWAIN COMPANY.

The Lake factory of this company at Nashua, N.H. is a brick building 540 feet long by 50 feet wide. Four stories and a basement are engaged in the manufacture of mens' shoes exclusively, the capacity of the plant being about 7,000 pairs per day.

The factory is driven throughout by induction motors supplied with power from the electric generating plant adjacent to the main building. A 250 kw. alternator direct connected to a Cooper engine supplies three phase 60 cycle current at 600 volts to the factory building through the switchboard shown in the illustration. The factory is equipped with a thoroughly up-to-date installation comprising thirty-four motors totaling 326 h.p.

The sole and upper leather used at the Lake street factory is cut into the required shape at one of the other factories of this company so that no cutting machinery is required. The uppers are assembled in the stitching room on the fourth floor which contains about two hundred stitching machines arranged in twelve groups. The line shaft for each group is connected by a silent chain belt to the motor which is suspended from the floor below. There is one 7\(\frac{1}{2}\) motor, the remainder being of 5 and 3 horse-power capacity.

On the third floor there are five motors, two of 15 h.p. capacity operating stitching machines, a 15 and 7\(\frac{1}{2}\) h.p. capacity driving groups of lasting and pulling over machines and a 5 h.p. motor driving a group of trimming and nailing machines.

Three 15 h.p. motors are used in the finishing room.
One of these motors drives a group of heeling machines and another a line of buffing and cleaning wheels operated from a line shaft about 200 feet in length; one machine is connected to this shaft every five feet. A similar drive is installed on the opposite side of the room. The main floor contains the company offices and the treeing and packing rooms. The several factory elevators are driven by standard induction motors and two 20 h.p. motors operate double 60 inch exhaust fans.

The factory is lighted throughout by 110 volt incandescent lamps supplied from the engine room through single phase transformers.
CQ-7
1 2 H.P. 835 RPM. 230 VOLT MOTOR DRIVING FINISHING AND BUFFING MACHINES. UTZ AND DUNN SHOE FACTORY.
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CLB-6-35 H.P. 625 RPM. 230 VOLT SHUNT MOTOR DIRECT CONNECTED TO TWO 60 IN. SLOW SPEED ARLINGTON FANS. UTZ AND DUNN SHOE FACTORY.

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HCB-14-500-514 250 VOLT ROTARY CONVERTER SUPPLYING UTZ AND DUNN SHOE FACTORY. ROCHESTER RAILWAY, LIGHT AND POWER COMPANY, STATION NO. 35.
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A good example of a shoe factory supplied by central station power is seen in the Utz & Dunn plant at Rochester, N.Y. This factory was recently enlarged and equipped with electric motors for driving the various machines. An arrangement was made with the Rochester Railway & Light Company for supplying direct current at 250 and 125 volts for the motor and lighting circuits respectively.

The manufacturing equipment of Utz & Dunn has a capacity of about 7,000 pairs of ladies' and children's shoes per day. As is the usual practice five floors are equipped with shoe machinery group driven by thirty-eight motors with a total capacity of 454 horse power. With the exception of two motors operating exhaust fans none of these are larger than 15 h.p.

The fourth story of this factory contains all of the stitching machines as well as a large portion of the upper cutting or "clicking" machines. A row of twenty-six cutting machines is driven by a 10 h.p. direct current motor. The stitching department is driven through countershafts and belting from the floor below by motors rated at 5, 7½ and 10 h.p.

A group of Goodyear outsole stitching machines is driven by a 15 h.p. motor; there are about thirty machines in this group including stitching, channelling, trimming, welt and turn, cutting and slashing, and sole leveling machines.

The motors driving the exhaust systems are also located on this floor. 35 h.p. shunt wound motor running at 625 r.p.m. is direct connected to two 60" fans. In this case the collect-
ing tubes are carried along the side of the room underneath the work benches.

Similar machines to those above noted are located on the second floor driven by six motors of $7\frac{1}{2}$, 10 and 20 horse-power capacity. A 3 h.p. motor is arranged to drive stirrers in the cement room for mixing cement, blacking, leather dressing, etc.

The offices and packing rooms occupy the main floor, the only machinery being used for repair work and stamping or embossing machines. Several small motors are employed ranging in size from $\frac{1}{2}$ to 3 horse power.

The stock and sole leather rooms occupy the basement and five motors of 5, 10 and 15 horse power capacity are used to operate a conveyor, and miscellaneous light power machinery. One of the 15 horse power motors operates about forty-five machines such as sole rounding, edge trimming, channelling and sewing machines.

The incandescent lamps are supplied from the 125 volt side of the three wire system and the ironing tools, embossing dies, etc. are also operated at this voltage.

In order to insure continuous service and good voltage regulation a 500 kw. regulating pole rotary converter was installed at the Rochester Railway & Light Company's sub-station near the factory and arranged to feed into the three wire system. The manufacturer is thus able to secure a low rate for electric power based on the maximum peak load; second, uninterrupted service backed up by several hydraulic and steam power stations; and third,
relief from the expense of maintenance and attendance of an isolated electric plant.
TWO TYPE KT 7 1/2 H.P. INDUCTION MOTORS DRIVING MACHINERY IN THE MAKING ROOM. 3 1/2 INCH LINE SHAFT DOWN THE CENTER OF THE ROOM REPLACED BY FOUR 7 1/2 H.P. MOTORS SPRINGVALE SHOE WORKS, SPRINGVALE, ME.

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One of the few New England shoe factories which depends upon water power for driving the machinery is located at Springvale, Maine, with water rights on the Mousam River. The capacity of this factory is now about twenty-four hundred (2400) pairs of shoes per day, the entire output being marketed by the Sears Roebuck Company. Under the new arrangement the power is supplied to the various departments by twenty-one motors ranging in size from $\frac{1}{2}$ to $7\frac{1}{2}$ h.p. with a 20 h.p. motor operating the exhaust fan. Electric power is generated by a water wheel driven generator rated at 94 kv-a. on a power factor of 80%. During periods of low water, and when the power requirements exceed the capacity of the water wheels, power is purchased from the Ossippee Valley Power Company which operates hydro-electric plants on this river and at West Buxton on the Saco River.

The economy in power, resulting from the use of electricity as the transmitting medium in place of belts and line shafting, is aptly illustrated by the recent changes made in this plant. The factory was originally driven by two water wheels geared to a line shafting with a combined rating of 105 h.p. This shaft was carried a distance of about 30 feet to the basement of the factory and to the several floors through counter shafts and belting. For a large portion of the year the available head of water was not sufficient to operate the entire factory and it was necessary to maintain a steam engine and the boiler equipment which could be utilized for assisting the water wheel drive.

On account of the necessity for an increased producing
capacity it was decided to make extensive changes and install electric drive throughout the factory. In order to make use of the available water power a 3-phase 600 volt generator was belted to the line shaft in place of the mechanical drive. This generator is worked in parallel with the central station supply and by opening the gates on the water wheels to their full capacity the entire water supply is utilized. Electrical energy at 550 volts 60 cycles is transmitted to the various departments with negligible loss and employed to drive the small motors belted to the counter shafts. By this change-over, nearly 300 feet of line shafting was eliminated, a large part of it being 3½ inches in diameter. The original drive also included several counter shafts and belt tightener on the main 15 inch belt, all of which were thrown out when the new motor equipment was installed.

The entire change-over from mechanical to electrical drive was made without interrupting the operation of the factory. A large motor was temporarily installed in place of the steam engine which was unable to handle the load and the small motors were belted to the various counter shafts in the different parts of the factory. The illustrations show the motors installed and a long line of shafting which had not yet been removed. During the few months that the motor equipment has been in operation it is found that an increased production can be obtained owing to the greater flexibility and improved speed regulation. It has also been found convenient to operate certain sections of the factory which were behind in their work for short overtime periods without the
necessity of supplying power to the entire factory.

An addition to the factory is now being built which can be very easily equipped with driving motors without the necessity of extending line shafts or belts.

EQUIPMENT OF SPRINGVALE SHOE WORKS

ATB 8 pole 94 kv-a, 900 r.p.m. 600 volts - Belt Driven from 65 & 40 h.p. water wheels

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<tr>
<td>Sole Leather Rm</td>
<td>7½</td>
<td>3</td>
<td>22½</td>
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<td>7½</td>
<td>2</td>
<td>15</td>
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<tr>
<td>Finishing Room</td>
<td>7½</td>
<td>2</td>
<td>15</td>
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<td>Main Floor</td>
<td>7½</td>
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<tr>
<td>Stitching Room</td>
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21 11½
An example of electric drive employing old shafting

221055 TYPE KT 15 H.P. 220 VOLT INDUCTION MOTOR DRIVING MACHINERY IN SCOURING ROOM. SCHLOSSER LEATHER COMPANY WALLAND, TENN.
INDEX 1-327-E-212.4
ELECTRIC DRIVE FOR TANNERIES

The output of the 951 establishments reported in the last census as engaged in the manufacture of leather shows an increase in 1909 of approximately 10% over that of 1904, the total production for 1909 being more than 142,700,000 hides and skins. While comparatively few of these tanneries are completely electrified a large number have installed partial equipments to meet the requirements for additional capacity.

In general the application of electric motors to the driving of tannery machinery offers the same advantages as in other industries with the distinctly important features of decreased power consumption and increased production for a given equipment.

Owing to the extended areas over which power must be transmitted the losses incurred in steam driven plants due to friction and belt transmissions frequently constitute from 35 to 70% of the total energy consumed. In addition to this loss several engines and isolated boiler equipments are usually necessary with high cost for attendance and maintenance. The major portion of this power cost may be eliminated by the application of the motive power direct to the various machines. The cost of energy in a plant operated in this manner becomes very nearly proportional to the work done.

Existing installations of electric motors for tanning machinery have already proved that a given equipment will do more work when electrically driven, due mainly to the greater uniformity of speed attained and to greater ease of control. Other advantages which indirectly affect the cost and quality of the product are:
greater cleanliness, materially reducing the percentage of damaged leather in the final process of finishing; most convenient and logical arrangement of machines, insuring the handling of the hides from one machine to another quickly and economically; reliability of operation since failure of any driving motor can effect only a small part of the plant machinery. This factor is of vital importance in tanneries since the failure of power at certain stages of the process will frequently entail a heavy loss.

Group or Individual Drive

A larger part of the existing installation of electric motors in tanneries is arranged under what is known as the group system of drive, one motor being employed to operate several machines through a counter shaft and chain or belt drives. As a matter of fact, many of the machines used for preparing leather are best adapted to group drive on account of the intermittent power requirements. This feature is especially notable on the heavy staking, rolling and glazing machines having reciprocating motion with the load applied only during a portion of the stroke.

On the other hand, machines requiring power for longer periods or high speed apparatus can well be driven by individual motors. The clumsy and expensive belt shifting device can be replaced by the electric switch conveniently arranged for control by the operator. Additional machines may be installed without interfering with the operation of those already in service and
with no additional outlay except for motors and installation. Overtime work can also be economically provided for either in large or small quantity, the power requirements being directly proportional to the work done.

Central Station or Isolated Plant Supply

Washing, tanning and dyeing operations require large quantities of steam and hot water and for this reason manufacturers are sometimes reluctant to purchase outside power preferring to install electric generators operated from steam engines formerly used to drive factory line shafts. A careful investigation will frequently show that operating costs can be materially reduced by taking energy from local supply systems since both investment and cost of maintenance are reduced. In localities remote from large hydro-electric developments or other central station plants, the steam turbine with alternating current generator offers an ideal unit for supplying electric power. By the addition of a "bleeder" valve low pressure steam may be taken from one of the turbines to supply all factory requirements. This unit is practically noiseless in operation, requires little attention and has a high efficiency over a wide range of load.

A.C. or D.C. Motors

On account of the presence of large quantities of moisture steam and acids or strong alkalis the motors must be exceptionally well insulated to insure uninterrupted service. The squirrel cage type induction motor combines features of simplicity and
durability which enable it to withstand the most adverse conditions as may be seen from the accompanying illustrations.

Aside from the inherent superiority of the induction motor over the direct current type for rough service the alternating current system offers further advantages because of the possibility of efficient transmission of power over large areas. Not only can this energy be transmitted at small loss but the cost of the initial installation is lessened owing to the difference in the amount of copper required for transmission wires.

Pumps and Fans

A large number of pumps is necessary in tanning establishments for transferring water and tanning liquors. These pumps when electrically operated may be direct connected to the driving motor and started or stopped by throwing the controlling switch. It is also possible to place the pump in the most convenient location regardless of the source of power.

Several fans are usually employed to expedite the drying of the hides and skins between the various operations of tanning, washing, and dyeing, and these are also most satisfactorily driven by direct connected motors. Many of these fans are required to operate twenty-four hours a day under conditions which require frequent attention when driven by mechanical means. The energy can be transmitted electrically with small loss to the most remote parts of the plant and controlled by conveniently located switches.
<table>
<thead>
<tr>
<th>Machine Type</th>
<th>Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unhauling machine</td>
<td>5 to 7 1/2 h.p.</td>
</tr>
<tr>
<td>Fleshing machine</td>
<td>10 to 15 h.p.</td>
</tr>
<tr>
<td>Belt Knife Splitter</td>
<td>10 h.p.</td>
</tr>
<tr>
<td>Setting out machine</td>
<td>5 h.p.</td>
</tr>
<tr>
<td>Wringer</td>
<td>7 1/2 to 10 h.p.</td>
</tr>
<tr>
<td>Seasoning machine</td>
<td>3 h.p.</td>
</tr>
<tr>
<td>Oil wash and dyeing drums (loaded)</td>
<td>5 h.p.</td>
</tr>
<tr>
<td>Measuring machine</td>
<td>1/2 h.p. B.G.</td>
</tr>
<tr>
<td>Shaving machines</td>
<td>3 to 5 h.p.</td>
</tr>
<tr>
<td>Shanking &quot;</td>
<td>3 to 5 h.p.</td>
</tr>
<tr>
<td>Glazing Jacks (group)</td>
<td>1 to 1 1/2 h.p.</td>
</tr>
<tr>
<td>Staking machines (group)</td>
<td>1 to 1 1/2 h.p.</td>
</tr>
<tr>
<td>Paddle Wheels (varying in length)</td>
<td>2 to 4 h.p.</td>
</tr>
<tr>
<td>Hide Reels</td>
<td>3 h.p. B.G.</td>
</tr>
<tr>
<td>Lime Mixer (4 ft. by 6 ft.)</td>
<td>5 h.p. B.G.</td>
</tr>
<tr>
<td>Hair Dryer</td>
<td>10 h.p.</td>
</tr>
<tr>
<td>&quot; Washer</td>
<td>5 h.p.</td>
</tr>
<tr>
<td>Rollers (group)</td>
<td>4 h.p.</td>
</tr>
<tr>
<td>Hide Kickers</td>
<td>15 h.p.</td>
</tr>
<tr>
<td>Scouring machine</td>
<td>3 to 4 h.p.</td>
</tr>
<tr>
<td>Blacking machine</td>
<td>5 h.p. B.G.</td>
</tr>
<tr>
<td>Leather Press</td>
<td>5 h.p.</td>
</tr>
</tbody>
</table>

TYPE 1 15 H.P. 220 VOLT FORM K INDUCTION MOTOR DRIVING FOUR SHAVING MACHINES. ENDICOTT, JOHNSON AND COMPANY, ENDICOTT, N. Y.
INDEX E-312:4 - E-327
ENDICOTT, JOHNSON & COMPANY

Probably the only shoe manufacturing establishment in the United States which builds its shoes complete from "hide to retailer" is the group of factories operated by Endicott, Johnson & Company in the adjoining towns of Endicott and Lestershire, N.Y. All of the tanneries and two of the large shoe factories are located at Endicott while three large shoe factories at Lestershire receive their leather from these same tanneries. The electrical equipment of these factories and especially of the tanneries includes many novel methods for securing the greatest flexibility and economy. Some of the most interesting of these motor drives are here illustrated and briefly described.

Generating Equipment

Two electrical generating stations are maintained at Endicott having a total capacity of about 1,600 kw. The older of these plants is adjacent to the shoe factory and contains the 500 h.p. engine used for mechanical drive. A generator of 200 kw. capacity belted to this unit and a 375 kw. direct connected set supply three-phase 60 cycle current at 2200 volts for driving the shoe factory motors.

In the new power house near the Sole Leather Tannery is a 500 kw. rope driven generator and a 625 kv-a. Curtis turbine generator. This station operates at 125 lbs. steam pressure condensing and the electrical end works in parallel with the first named station.

Power transmission is made at 2200 volts and suitable transformers are employed at the various buildings stepping down
to 220 volts for motor service and 110 volts for lighting.

Shoe Factories

The shoe manufacturing plant established about fifteen years ago has rapidly increased in capacity until it is now turning out more than 20,000 pairs of shoes per day in all styles for men, women and children, specializing in heavy work shoes and sporting lines. Five large buildings are required for manufacturing and storage and the shoe machinery is being rapidly changed over from steam engine to induction motor drive. Three large Corliss engines, each of 500 h.p. capacity, are now used for driving the machinery in these factories, but a portion of this power is converted into electricity by three belted alternators rated at 200, 150 and 75 kw. capacity. The two last named are used for lighting and power in the Lestershire factories.

About forty motors are now in service ranging in capacity from 3 to 10 h.p. with larger units for the exhaust fans. The stitching rooms at Endicott are operated entirely by 5 h.p. motors installed under the benches and belted to the counter shafts. In other parts of the factory, motors have been installed to relieve the excessive loads on the engine drives and to take advantage of the improved conditions of speed. It will be noted from the photographs that quite an advantage is obtained by operating these machines in groups since the operation is intermittent and it rarely occurs that two machines operate at the same instant.

The main manufacturing building at Endicott, which is more
TYPE I 40 H.P. 220 VOLT FORM K INDUCTION MOTOR DIRECT CONNECTED TO TWO STURTEVANT FANS. ENDICOTT, JOHNSON AND COMPANY
ENDICOTT, N. Y.
INDEX E-2151 - E-327
than 700 ft. in length, is devoted exclusively to the manufacture of heavy men's wear. The output of this factory has been rapidly increased and the power delivered by the engine being insufficient, motor drive has been resorted to in various parts of the building to relieve the overloaded steam unit.

One of the interesting features in connection with this factory is the method of installing the blower systems. This piping is placed on the outside of the building and besides saving space it is much simpler to install. The driving motor of 40 horse power capacity is mounted on a bracket between two 60 in. Sturtevant blowers. One of the photographs shows the blower with portion of the exhaust pipes.

Tanneries

All tanning operations are carried on in three large tanneries at Endicott. These are commonly referred to as the Sole Leather or Bark Tannery, the Upper or Chrome Leather Tannery and the Calf-skin Tannery and have a capacity of approximately 6,000 sides of leather per day. The entire output of finished leather is required for the companies' shoe factories.

The manufacturing equipment is thoroughly modern and employs induction motors for driving all machinery. With the exception of three or four group drives, the motors are of moderate capacity ranging from 3 to 20 h.p. In all there are about 120 motors in service with a combined rating of 1370 horse power. While group drive was mainly employed in the original installation, a large part of the motors operated during the past year have been intended
TYPE I-10 H.P. AND TWO TYPE KT 7 1/2 H.P. MOTORS DRIVING FLESHING AND UNHAIRING MACHINES. ENDICOTT JOHNSON TANNERS ENDICOTT, N. Y.
INDEX E-312.4-E-327
for individually driving the various machines.

The bark or sole leather tannery works in conjunction with the upper leather factory which is located on the opposite side of the roadway. In order to transfer those hides which are intended for upper leather to chrome leather tannery, a single track crane conveyor is installed operating between the two buildings. The car for this outfit is provided with 3 and 5 horse power motors for travelling and lifting. These motors are of the wound rotor type operated by controllers from the crane cage.

A large part of the salted hides treated in these two buildings are put through the preliminary stages in the sole leather plant, the operations of washing, softening, unhairing and fleshing being similar for both the sole and upper leather. The salted hides are first thrown into the "hide kickers" where they are softened and freed from salt with the assistance of running water. Three of these heavy machines are individually driven by 15 h.p. motors, the remainder being operated in a group by a 100 horse power motor.

After being thoroughly soaked and treated in lime for loosening the hair, the fleshing and unhairing operations are performed. The machines for this work are located with a view to reducing the amount of handling to a minimum with a resulting decrease in time and labor. The hides are transferred from one vat to the next by portable hide reels operated by 3 h.p. motors. Five of these reels serve as many rows of vats finally delivering the hides to five sets of fleshing and unhairing machines. These machines are also driven by individual motors suspended from
the ceiling and controlled by special switches which are placed just over the workman's head. A pair of ropes arranged for opening and closing the switch enable the operator to start or stop his machine electrically instead of using a belt shifting device.

The hair taken from the hides is a valuable by-product and is disposed of by machinery located in the corner of the beam house including two hair washers driven by a 10 h.p. motor, a centrifugal exciter driven by a 5 h.p. motor, two chain conveyors operated by 3 horse power back geared motors, which carry the partially dried hair to the hair dryer located on the floor above.

The skins intended for sole leather are now conveyed to the tanning vats or "tan yard" in the adjoining building while those suitable for upper leather go to the chrome tannery.

The finishing processes for undressed leather are comparatively simple after the tanning is completed. The hides are first thoroughly washed to remove all acid, put through wringers and dried on stretching frames. In the Endicott Johnson plant the tanning and washing drums are for the most part operated in groups as the most economical method. In the sole leather department a 50 h.p. motor drives twelve wash drums while the hide wringers are individually driven by 10 horse power motors. The rolling machines are driven in groups of four by 15 horse power motors arranged two on each floor.

Upper Leather Tannery

The upper or dressed leather requires additional processes which are performed at Endicott in what is known as the Upper
EIGHT TYPE KT 5 H.P. BACK GEARED MOTORS EACH MOTOR OPERATING ROCKERS FOR TWELVE TANNING VATS
INDEX E-312.4 - E-327
FIVE 5 H.P. 220 VOLT FORM K INDUCTION MOTORS DRIVING SHANKING MACHINES
ENDICOTT, JOHNSON AND COMPANY, ENDICOTT, N. Y.

INDEX E-3124-E-327
Leather Tannery. The main floor of this building contains tanning vats, drums, wash wheels and paddle wheels. These are for the most part driven in small groups. One of the most interesting of the motor applications is the method of operating the rockers which are used for keeping the tanning liquor in motion. Eight 5 h.p. back geared motors are employed, each geared to a counter shaft which operates the rockers for twelve vats. This arrangement gives a flexibility which effects a marked reduction in cost of power due to the fact that these rockers are operated only a portion of the time.

The lime reels also employ the back gear motor to good advantage. The use of the back gear allows a much more compact arrangement than could be obtained by belting, or by using one large gear for speed reduction. It is a simple matter, therefore, to totally enclose the motor and gearing protecting it from the liquids in the vats.

The setting out machine is also driven by a 5 h.p. back geared motor. This type of machine requires a very low operating speed and is driven by chain and sprocket from the back gear of the motor. A portion of the paddle wheels and tanning drums are driven in one large group by a 100 h.p. motor which was the initial installation for this room. All additions since then have been either 5 or 7½ h.p. motors driving small groups of paddle wheels. Two belt knife splitters are employed to split the leather into thicknesses suitable for use on the uppers. One of these is located on the main floor and the other on the second floor, both
being individually driven by 7½ h.p. induction motors. The finishing operations are performed mainly on the second floor. One of the groups on this floor consists of three oil drums driven by a 20 h.p. motor and two glazing jacks driven by 7½ h.p. motor. The shaving and shanking machines are driven in groups by 10 and 5 h.p. motors. The final drying is done on the 3rd floor which is amply ventilated by several fans driven by individual motors of about 10 h.p. capacity. The equipment of the Calfskin Tannery is in general similar to that of the Upper Leather Tannery, the difference being mainly in the size of the hides. In the Calfskin Tannery many of the skins are small enough so that they can be put through the processes whole instead of being cut into sides.

Since the Endicott-Johnson Company does practically all of its construction work electric motors have been used for a variety of applications other than tanning machinery. A cement mixer, driven by 5 h.p. motor, is kept in continuous service in different parts of the plant. In the machine and wood working shops four or five motors are employed for operating the various machines and all elevators throughout the plant are electrically operated.
SETTING OUT MACHINES DRIVEN BY 5 H.P. MOTORS
OHIO LEATHER CO., GIRARD, OHIO

PICKLE WHEELS DRIVEN BY 15 H.P. MOTOR
OHIO LEATHER CO., GIRARD, OHIO
10 H.P. Induction motor driving leather splitter
Ohio Leather Co.
The Ohio Leather Company operates one of the largest tanneries in the middle west and their plant at Girard, Ohio is equipped throughout with modern electrically driven machinery. Previous to 1907 the entire plant was operated by several isolated steam plants, but at this time, on account of the heavy expense involved in maintaining this equipment and also the requirements for additional capacity, it was decided to electrify the entire plant. In applying motors to various types of machinery the individual system of drive was used wherever possible. The installation now comprises 218 induction motors of the squirrel-cage type totaling 972 horse power. These motors are operated at 220 volts 60 cycles from engine-driven generators. The accompanying photographs show some of the drives employed in these tanneries. Individual drive is employed for operating belt-knife splitters, fleshing and unhairing machines, color drums, setting out machines and many others. Group drive, however, is employed for operating the glazing jacks, staking machines and also the shaving and shanking machines.

By the installation of electric drive in this tannery the company has been able to eliminate a large percentage of the line shafting and belting and thus reduce the friction loss to a minimum. In making additions to the present equipment it has been found a very simple matter to install new apparatus equipping each machine with its own driving motor.
TYPE KT-1 1/2 H.P. 220 VOLT INDUCTION MOTOR DRIVING TWO MEASURING MACHINES. A. C. LAWRENCE LEATHER COMPANY PEABODY, MASS.
INDEX E-327-3-312-4
TYPE 1-75 H.P. 220 VOLT FORM L INDUCTION MOTOR DRIVING 11 DRUMS
A. C. LAWRENCE LEATHER COMPANY, PEABODY, MASS.
INDEX E-327-E-312.4
TYPE 1-50 H.P. FORM L 220 VOLT INDUCTION MOTOR DRIVING 33 STAKING MACHINES
A. C. LAWRENCE LEATHER COMPANY, PEABODY, MASS.
INDEX 5-527-E-912.4
A. C. LAWRENCE LEATHER COMPANY

One of the largest tanneries in New England known as the A.C. Lawrence Leather Company is located at Peabody, Mass., a town which for many years has been noted for its tanneries. The manufacturing establishment of this company covers an extended area and comprises about thirty-four buildings with an average daily capacity of 1500 hides and from 60,000 to 70,000 skins. A large part of these buildings were originally supplied with power by several steam engines through rope and belt transmissions and long lines of shafting. Electricity was first adopted some seven or eight years ago, changing over the old systems to electric motor drive, and today practically the entire plant is operated electrically. The saving in the cost of power over the mechanical system has been estimated by the engineer to be from 30 to 40%.

The main generating station contains one 250 kw. and one 675 kw. direct connected generating units delivering 220 volt 60 cycle three-phase current. Plans are now completed for increasing the power supply by the installation of a 1000 kw. 2300 volt mixed pressure turbine generating set. This unit will meet additional power requirements and also relieve the present units of excessive loads. Current is distributed at 220 volts for the buildings near the engine room and at 2300 volts for transmission to newer part of the plant which is located about one mile from the main station.

A large part of the tanning machinery is driven in groups but individual drive is also extensively employed. Motors in all sizes are employed ranging from ½ to 75 h.p. The larger motors are of the wound rotor type with starting resistance
Engine Room  A.C. Lawrence  Leather
mounted on the rotor shaft, and the smaller sizes have bar wound rotor or squirrel cage winding. The large motors are thus capable of starting line shafting and the smaller motors can be thrown directly on the line.