

INDUSTRIAL COMMISSION OF WISCONSIN

FRED M. WILCOX, *Chairman*

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A. J. ALTMAYER, *Secretary*

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September 1, 1925

ELECTRICAL SAFETY

INTRODUCTION

During July and August of 1924, what one may be tempted to call "an epidemic of fatal electrical accidents" occurred in the industries of Wisconsin, in the handling of portable electrical equipment supplied from ordinary low voltage lighting circuits. Two of these accidents took place in handling the electrical vibrators used in foundries and one on an electrically operated sand riddle. Two more electrical fatalities occurred in handling ordinary electric extension lamps. As previously stated, electrical energy was supplied from ordinary lighting circuits, which is concrete evidence of the fact that ordinary lighting circuit voltages (110-220 volts) cannot be considered safe to life. In particular, conditions are conducive to fatalities with low voltages where floors are of earth or in direct contact with the earth. Such floors may be damp or even wet, and the perspiration from heat or strenuous work may have caused the palms of the workmen to become moist. Under these conditions, the handling of defective electrical apparatus or lamps results in a shock which is much more likely to prove fatal than under ordinary conditions. Therefore in industrial plants in particular, special efforts must be made to safeguard the electrical apparatus.

In September of the same year, the Industrial Commission issued a one page bulletin, giving a brief account of these accidents and very briefly outlining the proper remedy as specified by the Wisconsin State Electrical Code. Since then, many requests have been received from industrial establishments calling for more detailed information on just how to safeguard such apparatus. It therefore appears advisable to prepare a bulletin treating the subject in detail so that employers and owners will have no difficulty in understanding how to

proceed in reconstructing the portable apparatus used in their plants. If these instructions are followed, accidents from this cause should be practically impossible, provided good construction is followed by proper maintenance of the equipment.

Enclosure of live parts

Such electrical apparatus as drills and vibrators, which the workman must hold in his hands while they operate, obviously should have no exposed live parts from which a shock might be received or from which burns might occur through arcing or sparking. If stationary apparatus, which is handled only at infrequent intervals, is required to have no such exposed live parts, how much more important is it that the portable equipment, which is held in the hands during its use, be properly guarded? As a matter of fact, the Wisconsin State Electrical Code requires both classes of apparatus to have the live parts properly enclosed, and it would seem that common sense dictates the same procedure. However, apparatus having such exposed live parts is found in use and therefore employers and owners would do well to examine all of their equipment and discontinue the use of such as they may find violates this safety provision.

Grounding of Equipment

Electrical equipment, like other machinery, is subject to wear and tear with this exception: defects in other equipment may be discovered by careful inspection, but not necessarily with electrical equipment. Electrical apparatus when inspected may appear to be in good condition, but a short time later may fail while in use. All electrical apparatus contains coils or windings insulated from the metallic casing by rubber, cloth, paper, mica, etc. Any one of several causes, such as overheating, moisture, friction, may permit a leakage of the current flowing in the windings to the enclosing metal case. When this happens, the entire frame or case becomes alive and any person handling it, while standing on the ground or touching grounded surfaces, such as plumbing, radiators, sprinkler pipes, etc., may receive a serious shock. For this reason, the practice of effectively grounding the exterior metal cases of such equipment has come into vogue and is required by the Wisconsin State Electrical Code. By grounding is meant making an electrical connection between the equipment to be grounded and the waterpipe system. If no water service is available, then grounding may be accomplished by means of metallic plates buried deep under earth or by metallic rods or pipes driven deep into the earth.* When the exterior metal case, commonly called exposed noncurrent-carrying metal part, is effectively grounded, the person handling the equipment when the aforementioned leakage of current from the windings to the case takes place cannot receive a shock, because a low resistance metallic path to ground has been provided which in effect will by-pass the current around the body of the person handling the apparatus.

* See Section 103 of the Wisconsin State Electrical Code.

The manner in which this protection is secured is illustrated in Figure I, which happens to make use of a stationary motor as the example but the principle involved applies the same to portable equipment. The motor M is supplied from a secondary distribution system with 230 volts alternating current, stepped down from 2,300 volts by the transformer T, and its frame is insulated from the floor by a wood platform. A fault in the insulation of the armature makes the frame of the motor "live." Consequently, when the man in the illustration touches the frame, a current passes through his body to the ground, as shown by the arrows. The circuit from the ground back to the other side of the line is completed through a permanent protective ground connection to the secondary of the transformer T sup-

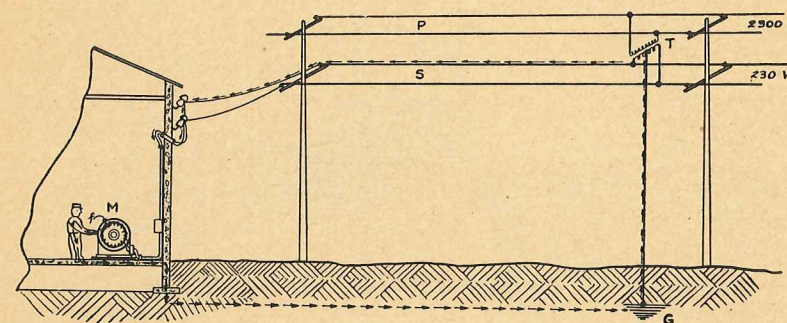


Figure I. Graphic illustration of protection afforded by grounding non-current-carrying metal parts of electrical apparatus. See text for description.

plying the motor, the purpose of which is to prevent primary voltage (2,300 volts) from being impressed upon the secondary when there is a cross between the primary and secondary lines. In the absence of such a protective ground on the secondary of the transformer, there might still be a return path over any one of numerous accidental grounds that may exist on the system. If, however, the motor in question, instead of being insulated, had its frame electrically connected to ground (water pipe), then a direct metallic path for the current would be provided and a person could not receive a shock by merely touching the frame of the motor.

If instead of a large motor at M, the man in the illustration were holding in his hands a portable drill motor or other electrical device, he would be in the direct path of the current when a current flows to ground through a fault in the windings. With a ground connection to the motor, as required by the code, practically all of the current would pass through this metallic, low resistance connection rather than through the path of his body, which comparatively has a much higher resistance. In other words, by providing a low resistance, metallic path to ground, the person handling the equipment is protected against a dangerous flow of current through his body. As

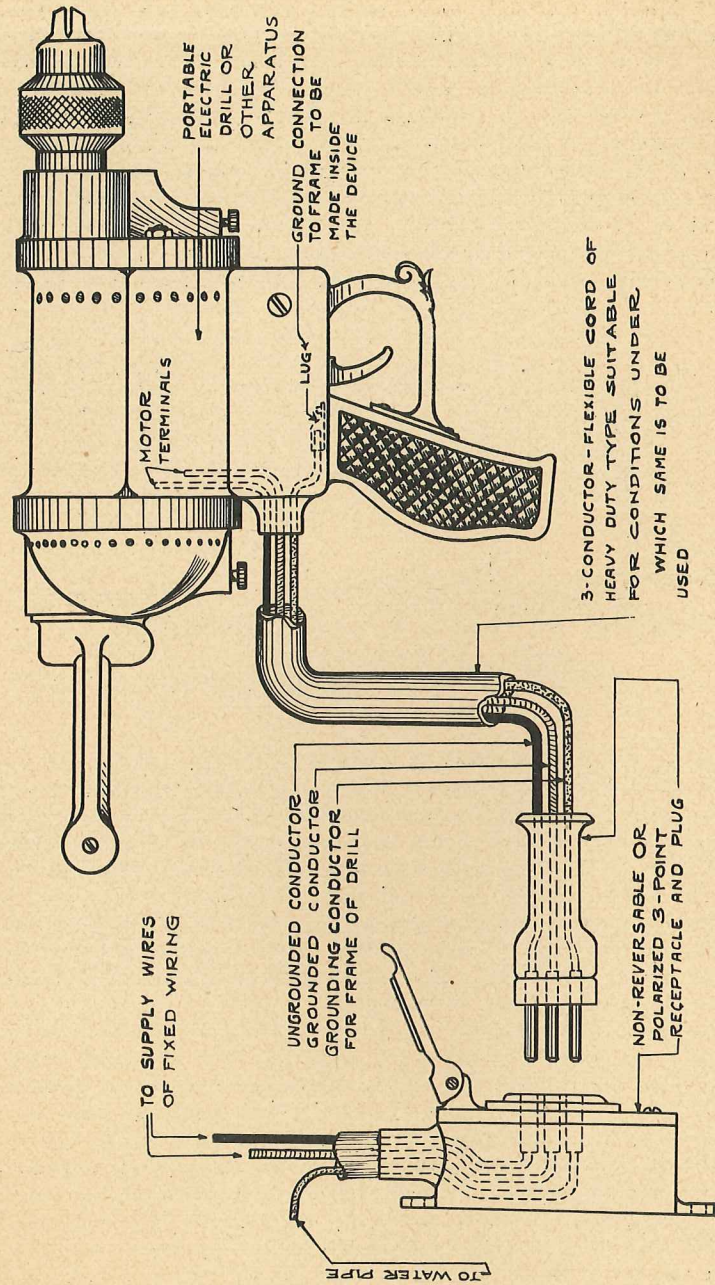


Figure II. Method of providing a grounding connection from external noncurrent-carrying metal parts of portable electrical apparatus to water pipe. For details see text.

previously stated, the effect is to by-pass the current around the body of the person handling the equipment.

If the magnitude of the current flowing to ground is sufficiently large, it of course should operate to blow a fuse or open a circuit breaker in the circuit, thus disconnecting the device from the source of supply. Whether or not this occurs, however, the person handling or touching the apparatus is protected through the presence of the ground connection. To be effective, however, such a ground connection should be of low resistance so that there will be as little impedance to the flow of the current as possible. If the resistance of the ground connection is too high, it will not by-pass a sufficient amount of the current to protect the persons handling the equipment.

In Figure II is shown a portable motor of the type ordinarily used for drilling purposes. It is supplied from a heavy duty flexible cord containing three conductors. Two of these conductors supply the electric current and the third serves as the grounding conductor for connecting the frame of the motor to the water pipe. Connection to the fixed wiring is made by means of a three point plug at the end of the three wire cord, which may be inserted into a three point receptacle outlet of the fixed wiring. The plug and receptacle are of the non-reversible or polarity type. That is, the plug can be inserted into the receptacle in one way only, thereby making impossible a reversed or wrong connection. Moreover, since connection to all three conductors is made simultaneously upon the insertion of the plug into the receptacle, it becomes impossible to operate the motor without having the frame properly grounded. As shown in the figure, the grounding conductor is connected to the frame of the motor at one end and to the water pipe at the other end. When the fixed wiring is installed in conduit, the conduit may be utilized for carrying the ground connection back to the water pipe. In that case, the grounding terminal of the three point receptacle may be connected electrically to the conduit system within the outlet box or fitting. This will save a run of copper conductor to the water pipe. It is assumed, of course, that the conduit system will be electrically and mechanically continuous to the point where the electric service enters the building and that the service conduit will be permanently and effectively grounded to the water pipe on the street side of the water meter, in the detailed manner outlined in the Wisconsin State Electrical Code.

While Figure II illustrates the conditions where a piece of portable apparatus is supplied from a single phase lighting circuit, grounding may similarly be provided for three phase portable equipment. In this case, a four conductor cord would be required, three of the conductors to furnish the electrical energy and the fourth conductor to serve for making the grounding connection. Likewise a four point non-reversible receptacle and plug would be required.

Other portable equipment, such as vibrators, sand riddles, etc., may be grounded in the same manner. The receptacle outlet of the fixed

wiring should be of a type different from ordinary lighting receptacles and it should not be possible to connect lighting equipment to such receptacles which should be reserved only for supplying energy to the other portable equipment. Electricians making installations should carefully study the provisions of the Wisconsin State Electrical Code.

Portable Electric Hand Lamps.

Ordinary brass shell sockets more or less generally have been employed in making up portable hand lamps—so-called extension cords—but they are a dangerous piece of apparatus for this use. Each year several fatalities occur through their use in this manner. Such sockets are entirely proper on lighting fixtures not within reach of grounded floors and surfaces and where they will not be handled very much, provided they are installed in a dry location. They should never be used where subject to moisture. Any portable hand lamp is likely to be exposed to moisture by being dragged over wet floors and in innumerable other ways.

If the construction of such sockets is examined, it will be noted that the exterior metal shell is insulated from the "live" inner screw shell by a cylinder of fibre. When this fibre is dry, it is a good insulator and provides adequate protection against shock. If it becomes moist, however, it loses its insulating properties with the result that the outer metallic shell of the socket becomes live. Naturally, when a person handles such a socket, particularly under the conditions heretofore mentioned, such person will sustain a shock. When discussing this hazard with men in the shop, they frequently mention that such shocks are a common occurrence. When it is considered, however, that each such slight shock is a potential fatality, one can readily appreciate the importance of discontinuing the use of these sockets for this purpose.

For some years now, the Wisconsin State Electrical Code has set forth in detail how portable electric hand lamps are to be constructed for safe use. In the first place, the number of these lamps in a factory should be reduced to the positive minimum by providing adequate and proper illumination from overhead lighting units, as required by the Industrial Lighting Code. Such portable lamps should only be used to provide supplementary illumination where needed. The electrical code requires portable electric hand lamps to be equipped with a keyless socket of non-combustible, non-absorbent insulating material, such as porcelain or composition, large handle of non-absorbent insulating material, such as impregnated wood, basket guard, reflector and reinforced weatherproof, packing house, armored reinforced weather-proof, cab tire, or other similar heavy duty water-proofed cords. Ordinary cotton covered twisted lamp cord is not suitable for the purpose. Such cords receive hard usage and should, therefore, be built to stand up a reasonable length of time under such usage. The basket guard may be made of metal but must be insulated from all live parts.

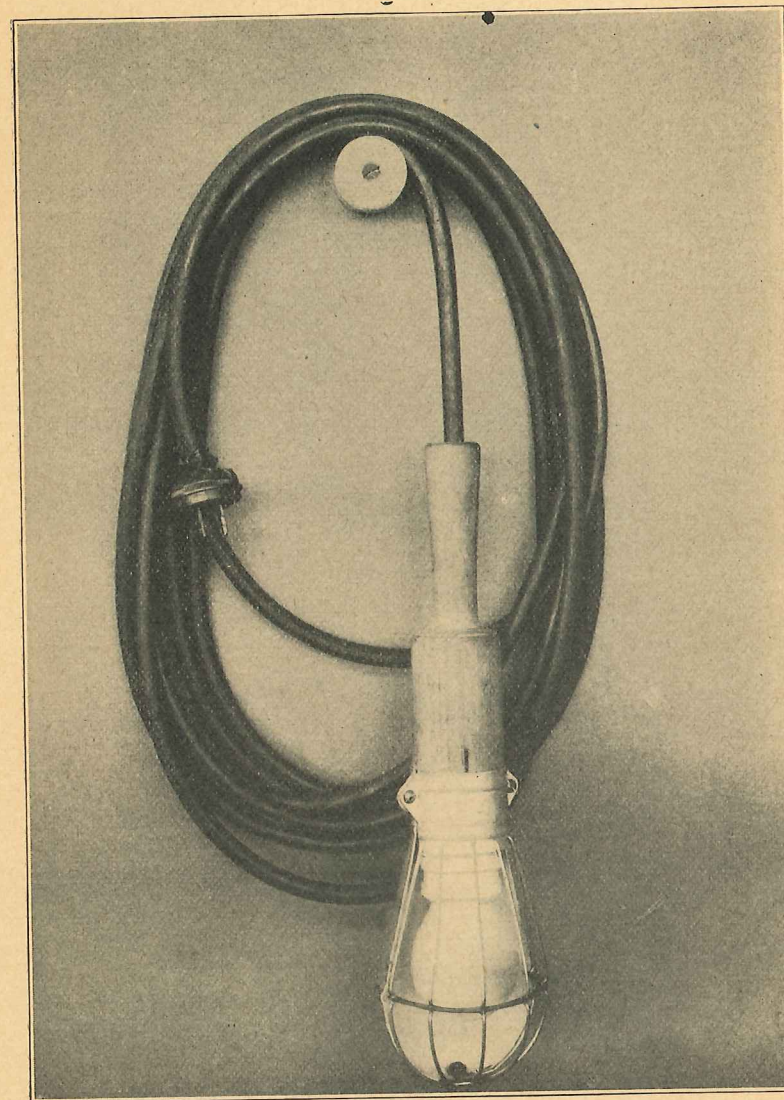


Figure III. Safe type of portable electric hand lamp as required by the Wisconsin State Electrical Code.

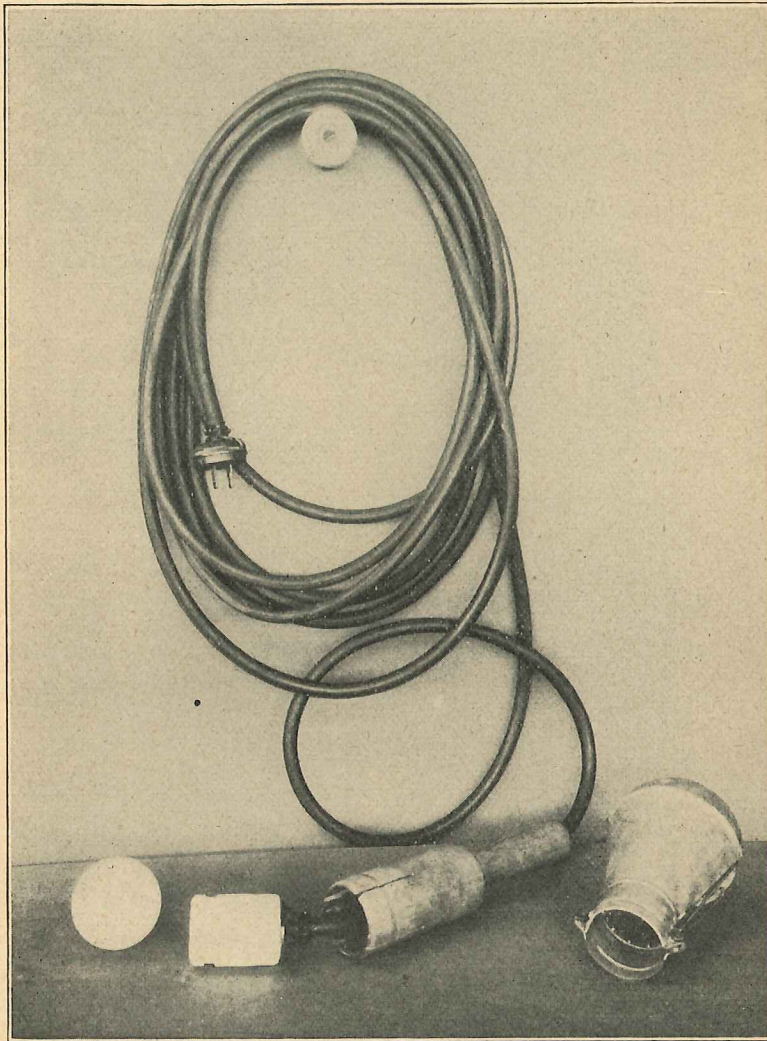


Figure IV. Same hand lamp as shown in Figure III, but disassembled to show construction.

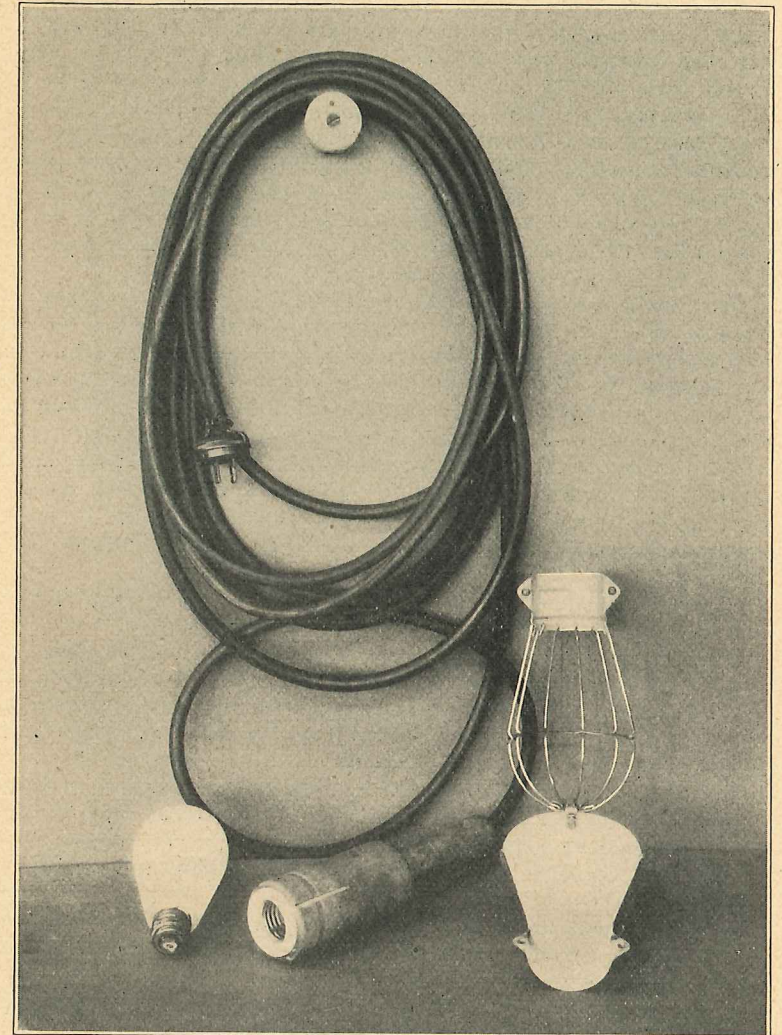


Figure V. Another view of the safe type of portable electric hand lamp.

Connection to the fixed wiring should be secured by plug connectors of the polarity type into proper receptacles of the fixed wiring. Such receptacles should be located at convenient points throughout the plant where it may be necessary to use portable hand lamps. Receptacles of the screw type are not permitted at locations less than four feet from the floor, and it is not advisable to use them at any elevation. If used, however, the plugs are required to be of the separable type. The wiring of the socket is required to be accomplished in such a manner that no strain can be placed on the terminal connections and the cords are not permitted to have joints but rather must be of one piece from the socket to the plug. While a hook is not required by the code, it is frequently advisable to equip the guard with a hook so that the lamp may be hung in position, freeing both hands of the workman for his job.

One wire of the cord should be identified in some manner so that it may be connected to the screw shell terminal of the socket and to the identified terminal of the plug. If the identification of the grounded conductor of the circuit is continuous (white braid) and has been run without transposition to the receptacle, as required by the Wisconsin State Electrical Code, it will be possible to carry the grounded conductor through to the screw shell of the socket of the portable lamp, thereby still further increasing the protection afforded the person handling the lamp. To prevent wrong connection of the portable lamp, the receptacle and plug are required to be of the polarity or non-reversible type.

Figure III illustrates a portable electric hand lamp, cord, plug and receptacle of the type required by the electrical code.

It will be noted that one terminal of the plug is broader than the other making it impossible to reverse polarity. Also the plug is equipped with a cord grip which relieves the electrical connections from strain when the plug is removed from the receptacle. The cord is of the cab-tire—heavy rubber outer covering—type, which withstands hard usage in damp locations. The large handle of wood is impregnated to make it non-absorbent. The reflector and basket guard are made of metal attached to the wooden handle and are thus insulated from all live parts. The lamp is all frosted to give better protection to the eyes.

Figure IV shows the same portable electric hand lamp disassembled. Note that the porcelain socket has a cord grip to relieve the electrical connections from any strain.

Figure V shows another view of this portable lamp illustrating the manner in which the reflector and guard are constructed.

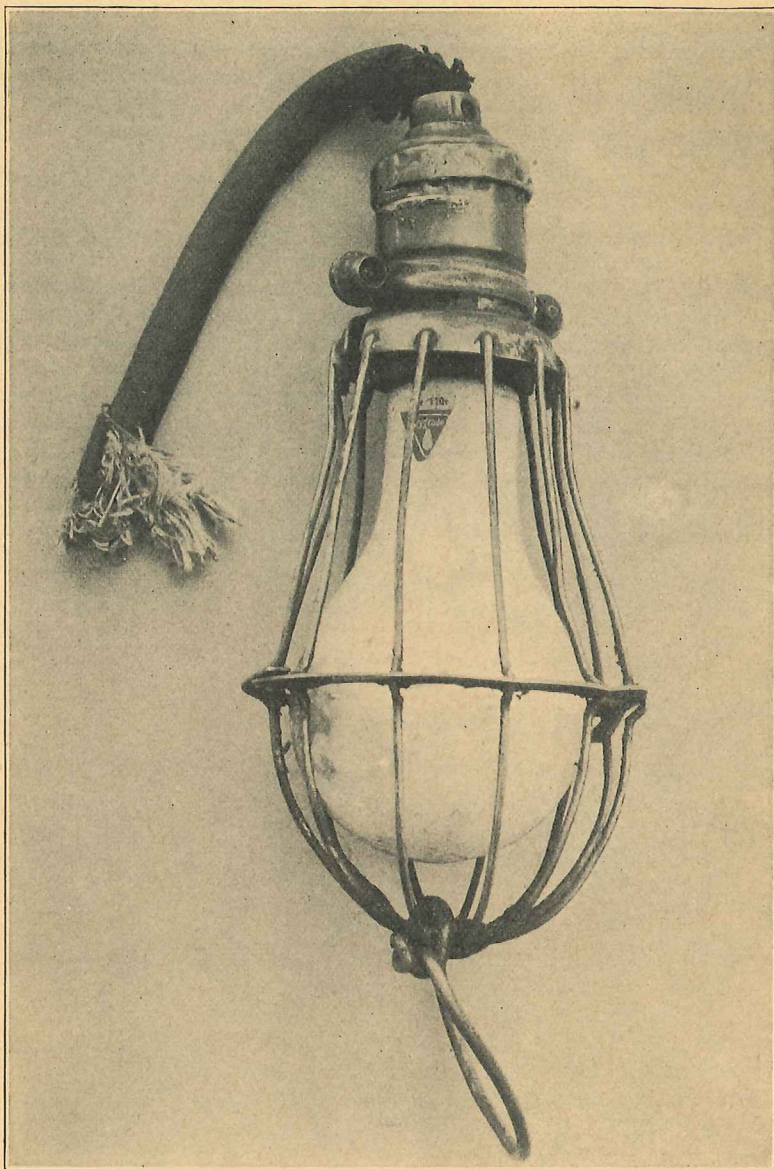
Statutory Provisions.

To the employer, it is of the greatest importance that his electrical equipment, in particular the portable equipment which must be handled by his employes, be up to code standard and safe, because the Workman's Compensation Act provides that where injury is caused by the failure of the employer to comply with any statute of the

state or any lawful order of the Industrial Commission, compensation and death benefits as provided for in the statutes shall be increased fifteen per cent. In the case of a death under these circumstances, an employer would be liable for as high as \$840.00 increased compensation which he would be required to pay out of his own pocket, since his insurance carrier is not liable for the amount, except in the case where the employer is not solvent.

Acknowledgment

Credit for the inception of this bulletin is due to the Accident Causes and Remedies Committee, of the Safety Division of the Milwaukee Association of Commerce, Mr. Fred Graper, Chairman. Valuable suggestions were received from Messrs. Frank R. Daniel, of the Wisconsin Inspection Bureau, and William A. Haig, Chief Electrical Inspector of the city of Milwaukee. Figure II, illustrating the grounding of portable electrical apparatus, is given by courtesy of the Diagram Committee, of the Western Association of Electrical Inspectors. Whereas Figures III, IV and V were received from Mr. George E. Cooper, Chief Electrician of the Allis-Chalmers Manufacturing Company. These figures illustrate a hand lamp made by Mr. Cooper's department for use in the Allis-Chalmers plant.



DANGEROUS—DO NOT USE

This dilapidated, improper and dangerous portable electric lamp *killed* the employee to whom it was furnished for use. If you have any like it in your plant, *get rid of them*. See page 6 of text.

Industrial Commission of Wisconsin

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May 15, 1925

UNIFORM ELECTRICAL ORDINANCE

INTRODUCTION

Under the Wisconsin Statutes, each city or village may enact local ordinances providing for electrical inspection, and it is urged that this be generally done since state inspection is not feasible. To be sure, electrical inspections of factories, mercantile and public buildings are made as part of the regular safety inspections of such buildings, but they occur at insufficient intervals. However, private buildings, which constitute the big bulk of the work, are uninspected if no local inspection work is done. Since we now have a uniform electrical safety standard, known as the Wisconsin State Electrical Code, a uniform enforcement of this code is desirable. With this end in view, an electrical ordinance has been drafted and is presented, herewith, as a good form to be followed in drafting local electrical inspection ordinances. It embodies all features which have been found to be practical. Some of the smaller communities may prefer to dispense with the licensing of electricians. If so, Sections 7, 8, 9 and 10 may be omitted. It is advisable in that event, however, to provide for some board of arbitration to settle controversies between the electrical inspector and owners of condemned installations in accordance with the procedure outlined in Section 11.

Acknowledgement is made of the valuable assistance in the preparation of this uniform ordinance rendered by Frank R. Daniel, Chief Engineer, Wisconsin Inspection Bureau. The latter organization in 1921 published a model electrical ordinance, many provisions of which have been incorporated herein. Moreover, the foregoing ordinance forms the basis of a number of city electrical ordinances now in effect in this state.

ELECTRICAL ORDINANCE

(To be adopted under authority of Sections 66.05—8 (c) and 62.11, sub-section 5 of the Wisconsin Statutes.)

An ordinance regulating the installation and maintenance of electrical wiring and equipment for the production, modification,

regulation, control, distribution, utilization or safeguarding of electrical energy for mechanical, chemical, heating, lighting or similar purposes; creating the office of electrical inspector and providing for the inspection of all such construction; requiring the licensing of master electricians; and fixing a penalty for violation.

The Common Council of the city of _____ ordains as follows:

Construction Requirements. Section 1. All electrical wiring and equipment for the production, modification, regulation, control, distribution, utilization, or safeguarding of electrical energy for mechanical, chemical, heating, lighting or similar purposes, shall be so installed and maintained as to be safe to life and property. Such construction shall further comply with the Wisconsin State Electrical Code promulgated by the Industrial Commission of Wisconsin and any amendments thereto; in matters not covered by said code, the National Electrical Code, as approved by the American Engineering Standards Committee and the National Electrical Safety Code as approved by the American Engineering Standards Committee, shall be prima facie evidence of safe construction methods.

Electrical Inspector. Qualifications, Appointment, Salary, Duties. Section 2. 1. The office of electrical inspector is created hereby. To be eligible for appointment as electrical inspector, a person shall qualify as a competent master electrician with at least two years practical experience in the trade or two years training in a recognized college of electrical engineering and a satisfactory knowledge of the safe construction of electrical wiring and equipment and all laws and regulations pertaining thereto in this state.

2. The electrical inspector shall be appointed by the mayor by and with the advice and consent of the Common Council and shall report to the mayor. The term of office shall be indeterminate. Removal from office shall be for cause only, after a fair and just trial, before the Common Council. Before entering upon the discharge of his duties, the electrical inspector shall file a bond in the sum of \$1,000.00 payable to the city of _____, said bond to be approved by the Common Council and conditioned upon the faithful performance of his duties. The electrical inspector shall also take and subscribe an oath which together with the certificate of his appointment shall be filed with the city clerk.

3. The electrical inspector shall receive a salary of _____ dollars yearly.

4. The electrical inspector shall devote his full time to enforcing the provisions of this ordinance. He shall make all inspections and keep a complete record of permits issued, inspections made and any other official work performed under the provisions of this ordinance.

5. The electrical inspector shall have the right during reasonable hours to enter any public or private buildings in the discharge of his

official duties and shall have the authority to cause the turning off of all electrical currents and cut or disconnect, in cases of emergency, any wire where such electrical currents are dangerous to life or property or may interfere with the work of the fire department.

6. It shall be unlawful for the electrical inspector to engage in the business of electrical wiring and construction either directly or indirectly and he shall have no financial interest in any concern engaged in such business in the city of _____, at any time while holding office as electrical inspector.

7. Flagrant or repeated failure to carry out the duties of his office, any dishonest practice or practices in connection with his work or violation of any of the provisions of this section shall constitute sufficient cause for dismissal of the electrical inspector, but he may be removed for other just cause.

Permits. Section 3. No alterations or additions shall be made to the existing electrical wiring and equipment of any building, nor shall any new electrical wiring or equipment be installed in any building, without first notifying the electrical inspector and securing the permit, provided for hereinafter, except minor repair work, such as repairing flush and snap switches, replacing fuses, changing lamp sockets and receptacles, taping bare joints and repairing drop cords.

Inspection Fees. Section 4. Application for permit to install electric wiring and equipment shall be made to the electrical inspector on forms supplied by the city. Such application shall indicate the nature and extent of the electrical installation and in the case of large installations may be required to be accompanied by a plan in the discretion of the electrical inspector. Before permit is granted, the following fees shall be paid to the electrical inspector:

A minimum charge of \$1.00 for installation of two circuits or less; two to five circuits, \$1.00 for first two circuits, 50 cents for each additional circuit.

Five to twenty-five circuits, \$2.50 for first five circuits, 25 cents for each additional circuit.

Fifty or more circuits, \$10.00 for the first 50 circuits, 5 cents for each additional circuit.

Fixture Work.

A minimum charge of \$1.00 for installation of 10 fixtures or less. Ten or more fixtures, \$1.00 for first 10 fixtures, 5 cents for each additional fixture.

Clusters to be charged for same as fixtures.

Drop Lights to be charged for same as fixtures.

Arc Lamps, Mercury-Vapor Lamps, Fans.

A minimum charge of \$1.00 for installations of two lamps or fans or less; two or more lamps or fans, \$1.00 for first two lamps or fans, 25 cents for each additional lamp or fan.

Motors and Generators (including feeders).

First machine, \$1.00.

Two to five machines, \$1.00 for first machine, 50 cents for each additional machine.

Five or more machines, \$2.50 for first five machines, 25 cents for each additional machine.
Heating devices to be charged for same as motors and generators.

Certificate of Inspection. Section 5. (1). No electric wires shall be covered up or concealed in any manner whatsoever, before the electrical inspector has been notified and given 48 hours in which to make the inspection required hereby: Nor shall any electric wiring be so concealed, if the electrical inspector upon inspection finds they are installed in violation of Section 1, until the necessary corrections have been made and approved by the electrical inspector.

(2). No electrical wiring or equipment shall be connected to the electrical service or the current turned on, unless the electrical inspector has been notified of the completion of the installation and given 48 hours in which to make the inspection required hereby: Nor shall any electric wiring or equipment be connected to the electrical service if the electrical inspector upon inspection finds it to be installed in violation of Section 1.

(3). The electrical inspector in his discretion may issue permits for temporary service where power and light are needed to complete the erection of a building.

(4). When final inspection has been made, and provided the electrical wiring and equipment has been found to be fully in compliance with Section 1, the electrical inspector shall issue a certificate of inspection, authorizing the connection to the electric service and turning on of the current.

License. Section 6. No person, firm or corporation shall engage in the business of installing electrical wiring and equipment for the purposes listed in Section 1 in the city of _____, unless all such work is done under the direction and supervision of a master electrician, who has been licensed as provided for hereinafter.

Examination for License. Section 7. (1). Any person desiring to be licensed as a master electrician, shall make application to the electrical inspector, accompanying such application with a fee of \$10.00. Thereupon the Board of Examiners of electricians shall examine such applicant, at such time and place in the city of _____, as it shall designate but not later than ten days thereafter, to determine applicant's qualifications and fitness as a master electrician. The examination shall be practical and elementary in character but sufficiently strict to test the competency of the applicant.

(2). When and after the applicant has passed said examination satisfactorily, the electrical inspector shall issue a master electrician's license to such applicant authorizing him to direct and supervise the installation of electrical wiring and equipment as required by Section 6.

(3). Failure to pass the examination shall not entitle the applicant to the return of the fee aforementioned; but the applicant shall

be entitled to a second examination six months thereafter without payment of another fee.

Board of Examiners of Electricians. Section 8. The Board of examiners of electricians shall consist of the mayor or a member of the common council designated by the mayor, who shall be chairman of said board, the electrical inspector, and a licensed master electrician, appointed for one year by the mayor by and with the advice and consent of the common council.

License Fees. Section 9. (1). The fee required by section 7 shall entitle applicants who have successfully passed the examination by the board of examiners to the initial master electrician's license, which shall expire on the first day of _____, of the month of _____, following the date of its issuance.

(2). A master electrician's license may be renewed within 30 days of the expiration thereof upon the payment of the annual renewal fee of five dollars. Such renewal shall expire on the first day of _____, of the year following such date of renewal.

(3). If a license is permitted to expire, the former holder thereof shall have the same status as a person not previously licensed.

Revocation of License. Section 10. (1). The board of examiners of electricians may suspend or revoke any master electrician's license, issued pursuant hereto, upon proof that such license was obtained by fraud or misrepresentation or through error, or that the holder thereof is grossly incompetent or has been guilty of any dishonest practice or practices in connection with his work as a master electrician, or for flagrant or repeated violations of this ordinance and laws relating to electrical work; provided, that before any license is revoked, the holder thereof shall be given written notice enumerating the charges and specifying a date not less than ten days after the service of such notice, on which the holder shall be given a hearing by the board of examiners of electricians and an opportunity to present testimony in his behalf. Appeal from the findings of the board of examiners may be made within ten days to the common council, whose findings shall be final.

(2). A license may be suspended or revoked for a period not exceeding one year in the discretion of the board of examiners of electricians.

(3). Any person whose license has been suspended or revoked may, after the expiration of the term of suspension or revocation, apply for a new license in the manner provided for a master electrician's license in Section 7.

Arbitration. Section 11. When the electrical inspector condemns all or part of the electrical work of any building, the owner may within five days after receiving written notice from the electrical inspector, file a petition in writing for a review of said action of the electrical inspector to the chairman of the board of examiners, upon receipt of which said board shall at once proceed to determine whether

said electrical construction complies with this ordinance, and within three days shall make a decision in accordance with its findings.

Penalty. Section 12. Any person, firm or corporation who shall fail to comply with any of the provisions hereof, shall upon conviction thereof, be punished by a fine of not less than ten dollars nor more than fifty dollars and in default thereof, by imprisonment not less than ten, nor more than ninety days, together with the costs of prosecution.

Repeal of Conflicting Ordinances. Section 13. All ordinances or parts of ordinances conflicting with the provisions of this ordinance are hereby repealed.

Liability of Owner of Electrical Wiring and Equipment. Section 14. This ordinance shall not be construed to relieve from or lessen the responsibility or liability of any party owning, operating, controlling or installing any electrical equipment for damages to anyone injured or any property destroyed by any defect therein, nor shall the city be held as assuming any such liability by reason of the inspection authorized herein, or certificate of inspection issued as herein provided.

Appropriation. Section 15. All moneys received by each and every person for or in behalf of the electrical inspector, under Sections 4, 7 and 9, and any fines collected under Section 12 shall be paid within one week after receipt into the city treasury, and are appropriated therefrom for electrical inspections as provided for herein.

Ordinance to take effect. Section 16. This ordinance shall take effect and be in force thirty days after its passage and publication.

Suggestion. When a municipality does not feel ready or able to assume the expense of a full time electrical inspector, it is suggested that the building inspector, fire chief, electrician of fire department, superintendent of electrical plant, city engineer or some other municipal employee having adequate qualifications be appointed temporary electrical inspector.

Temporary Inspector. Section 17. Until such time as a full time electrical inspector is appointed in accordance with the provisions of this ordinance, the _____ shall act as electrical inspector and shall be vested with all the power conferred upon the electrical inspector by this ordinance. The powers granted to the _____ shall automatically lapse when a full time electrical inspector is appointed in accordance with the provisions of this ordinance.

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May 1, 1925

ELECTRICAL SPECIFICATIONS

INTRODUCTION

More satisfactory electrical installations in buildings of their design no doubt is the desire of the architects of this state. Yet experience in the examination of many electrical plans and specifications indicates to this commission that much of the present dissatisfaction and friction with the electrical contractors and inspection authorities might be avoided by giving more attention to the form and contents thereof. Herein are given a number of practical suggestions which it is believed will be helpful to architects and others bearing the responsibility for the design of electrical installations in buildings.

ELECTRICAL SPECIFICATIONS

SUGGESTIONS TO ARCHITECTS INTENDED TO AID THEM IN THE PREPARATION OF ELECTRICAL SPECIFICATIONS

1. Bids

Under this heading, instruct the bidder as to the detailed manner in which bids are to be taken, similarly to customary practice in other lines of construction.

2. General Description

Briefly describe the installation to be made by the bidder and what labor, apparatus and material he is to furnish. Indicate that the specifications and the accompanying drawings are to be closely followed, and that the specifications and drawings supplement each other and are intended to provide for a complete installation, placed in service, delivered to, and accepted by the architect for the owner.

3. Legal Requirements

State that all work shall conform to the requirements of the Wisconsin State Electrical Code, and any additional local regulations. Require successful bidder to secure and pay for any necessary permits and inspections required by law.

Note: Do not include in the specifications any matters covered by the code. Limit the specifications to necessary details of the specific installation. In preparing plans use standard wiring symbols approved by the American Engineering Standards Committee.

4. Measurements

Indicate that the location of outlets and apparatus, as shown on the drawings, are not necessarily accurately to scale, and that the successful bidder, hereinafter called the electrical contractor, must make his own measurements on the premises and must assume responsibility for errors which could be avoided by checking and inspecting as required.

5. Delivery of Material

Require the electrical contractor to confer with the architect and other contractors on the job, regarding the delivery of material, so as to avoid unnecessary delays in the prosecution of the work. If any material or apparatus is to be furnished by the owner, call attention to this fact here and indicate where in the specifications such material or apparatus is enumerated.

6. Material and Workmanship

Require all materials, apparatus and fittings to be in accordance with Wisconsin State Electrical Code standard, and preferably such as bears the label of the "Underwriters' Laboratories". In addition, require all workmanship to be first class and to be executed fully in accordance with the specifications and drawings.

7. Cutting and Fitting

Require the electrical contractor to do all cutting and fitting necessary for his work. State that other necessary patching shall be done by other contractors. Require the electrical contractor to exercise due care against damage to the work of other

contractors, and to leave his work in such condition that the building remains uninjured, to the satisfaction of the architect.

8. Service Connection

Unless the drawings show definitely where the service is to enter the building, require the electrical contractor to confer with the electric service company as to the best and most convenient location for entering the building.

9. Service Switch or Switchboard

Preferably indicate on drawings, or in specifications, where the service switch, or in the case of large installations, the service switchboard, is to be located. If this is not done, require the electrical contractor to consult the electric service company supplying the service. In any case, require the electrical contractor to consult the electric service company about the installation of meters. Where a service switchboard is to be installed, it is recommended that a detailed drawing of this board be prepared, or that at least a full description of the switches and apparatus to be mounted thereon be included in the specifications. Proper space must be allowed for the service switch or switchboard in a readily and safely accessible location. See Orders 1120, 1142, 1311. Preferably install a switchboard in a separate room not used for other purposes.

10. Wire Shafts

The architect should realize that electrical equipment requires proper space, and hence in large buildings, he should provide for one or more wire shafts for the accommodation of risers, distribution cabinets, etc. Such wire shafts should be of ample dimensions, and preferably of fireproof construction.

11. Changes, Additions and Omissions

Require the electrical contractor to secure written permit from architect before making any changes, additions, or omissions in the specifications and drawings. State that no compensation for such changes, additions and omissions will be allowed, unless the foregoing requirement is fully carried out by the electrical contractor.

12. Character of Electric Service

Specify the character of electric service to be supplied: (1)

for lighting, (2) for power. If direct current is to be supplied, indicate the voltage, and in the case of lighting, whether or not the service will be two-wire or three-wire. If alternating current is to be supplied for lighting, indicate the voltage and whether the service is to be two-wire or three-wire, and in the case of power service, whether it will be single phase or polyphase, the frequency, the voltage, and the number of wires.

13. Service Wires and Mains

Preferably specify the size of service wires, feeders and sub-mains. If this is not done, specify the basis on which the electrical contractor shall calculate their sizes. Specify the maximum permissible drop in voltage permitted with the completed installation, and all lights and apparatus in operation about as follows:

"All wires shall be of such size that with all lights burning and other apparatus in operation, there will be no undue heating of wires or cables, and the drop in voltage between the service switch and any light or power outlet shall not be greater than four per cent of service voltage. The drop in voltage of any branch circuit, from the distribution cabinet to the farthest lamp, with all lights on the circuit burning, shall not be greater than two per cent of service voltage."

14. Service for Emergency Light

If the building is a theatre, school, or a factory, mill, office or other work place, a special service for emergency lighting is required and should be specified. See theatre lighting in electrical code, industrial lighting code, or school lighting code.

15. Motors and Motor Circuits

List the number and type of motors to be installed, where they are to be located, their horse power, and their speed. It is preferable to specify the size of wires of branch circuits supplying motors, keeping in mind code requirements and the matter of voltage drop.

16. Fans

Describe the number and type of fans to be installed, where they are to be located, and method of supporting them.

17. Fixtures

Usually the fixtures are supplied by another contractor. However, the electrical contractor is frequently required to hang the fixtures. If so, the number and type of fixtures to be hung by the electrical contractor should here be listed.

Note. When selecting fixtures, refer to the industrial and school lighting codes for buildings of these respective classes.

18. Type of Wiring to be Installed

Specify whether wiring is to be in conduit, armored cable, metal molding, knob and tube work, or open wiring.

Note. The service wires of all installations are required to be installed in rigid metal conduit. Moreover, various other portions of the wiring of a building may be required to be enclosed in conduit, armored cable, or metal molding; and, finally, certain classes of buildings are required to be entirely wired in conduit. See Order No. 1310-b, of the Wisconsin State Electrical Code. Also consult local ordinances.

19. Conduit

It is advisable to specify the type of conduit desired; i. e., galvanized, sherardized, black enamel.

20. Wire

If wire better than electrical code standard is desired, it is well to specify the quality desired.

21. Switches

In order that bids may be comparable, specify in detail the type of switches desired for the various purposes; for instance, in the case of lighting, specify whether or not push button, toggle, or snap switches are desired. Specify the elevation and the manner in which the switches are to be mounted. (See order 1350)

22. Outlet Boxes and Fittings

Describe the type of outlet boxes and fittings desired. For outlets at which fixtures are to be installed, always insist upon the use of deep boxes having tapped ears and containing a fixture stud, and for wall bracket outlets specify the addition of a cover which will reduce the opening in the plastered wall to a maximum width of two inches horizontally.

For 220 volt plug outlets, serving electric logs or other 220

volt equipment, require the use of a receptacle and plug not interchangeable with the 110 volt lighting receptacles.

23. Distribution Cabinets

In large installations, make a drawing of a typical distribution cabinet to be supplied. In any case, describe the cabinet and the enclosed panel boards, or assemblies of cutouts, switches, etc., to be installed, bearing in mind that for lighting such cabinets and enclosed cutouts are required to be dead-front. See Orders 1353 and 1354.

24. Drop Lights

In general, it is well to require the electrical contractor to furnish and install drop lights and receptacles mounted in the covers of outlet boxes. Heavy duty cord is more satisfactory than ordinary twisted cord, and in many locations is required by the code. See Order 1346.

25. Lamps

State whether or not the electrical contractor shall furnish lamps, and whether or not he shall be responsible for their installation. See school lighting and industrial lighting codes for these classes of buildings.

26. Electrically Heated Devices

Specify the number and type of electric ranges, logs or other heating devices, where they are to be located and their rating in volts and amperes. Preferably specify the size of the wires of branch circuits supplying such equipment.

27. Grounding

While the electrical code requires proper grounding of the service wires and the other equipment, it is well to state in the specifications that the electrical contractor will be responsible for properly carrying out the code requirements in this respect.

28. Miscellaneous Items

Such equipment as annunciators and bells, push buttons, signs, watchman's systems, interior telephones, telegraph outlets, fire alarms, burglar alarms, electrical clocks, program clocks, spe-

cial devices for controlling lights, and special light features, should be dealt with in detail under separate heads in the specifications.

29. Special Rules

Attention is directed to the fact that in garages, theatres, motion picture studios, hazardous locations, etc., the special rules in the Wisconsin State Electrical Code should be consulted when writing the specifications pertaining to such installations.

30. Transformer Vaults

Where transformers are to be installed within the building, and they are of such type, size and capacity as to require their installation in a transformer vault, the electrical code should be consulted for details on the design of the vault. See Order 1356.

31. Schedule

It is frequently helpful in obtaining bids to include with the specifications a complete summary of all outlets, fixtures, apparatus and equipment throughout the building.

32. Payments

It is well to provide for the usual certificate of payment, holding back a portion of the payments due, and final payment upon final inspection and acceptance of the installation, both by the architect and the electrical inspection department having jurisdiction.

CONCLUSION

Whenever in doubt concerning the electrical code and its application to the particular installation in question, consult the inspection department having jurisdiction before proceeding. It is always advisable to discuss with the inspection department the details of large installations, particularly for public buildings such as theatres and schools. Architects who make a practice of doing so on the whole are securing better electrical installations and save expense for their clients by avoiding the necessity of costly construction changes. In other words, the time to make changes is at the time the specifications and drawings are being prepared and before bids have been taken.