

NEW JERSEY STATE LIBRARY
3 3009 00556 3442

CODE
FOR THE
SAFEGUARDING
OF

Mechanical Power Transmission Apparatus .

PUBLISHED BY

New Jersey.

DEPARTMENT OF LABOR,

OF THE STATE OF NEW JERSEY

ANDREW F. McBRIDE, Commissioner of Labor

PROPERTY OF

1924

RECEIVED
JAN 25 1927
RECEIVED

ISSUED BY

W. of Labor

NEW JERSEY STATE LIBRARY
TRENTON

Bureau of Electrical and Mechanical Equipment ,

ROWLAND H. LEVERIDGE

Chief of Bureau

DO NOT CIRCULATE

TRENTON, N. J.
STATE GAZETTE PUBLISHING Co.

1924

NJ/KAB
LI 198
1924

Copy 1

TABLE OF CONTENTS

SCOPE, INTERPRETATIONS, MANDATORY AND ADVISORY REQUIREMENTS, DEFINITIONS

PART 1—PRIME MOVERS

SECTION 10—PRIME MOVER GUARDS

- Rule 100 Flywheels
- Rule 101 Cranks and Connecting Rods
- Rule 102 Tail Rods or Extension Piston Rods
- Rule 103 Governor Balls

PART 2—MECHANICAL POWER TRANSMISSION EQUIPMENT

SECTION 20—SHAFTING

- Rule 200 Installation
- Rule 201 Guarding Horizontal Shafting
- Rule 202 Guarding Vertical and Inclined Shafting
- Rule 203 Projecting Shaft Ends
- Rule 204 Shafting Located in Basements, Etc.

SECTION 21—PULLEYS

- Rule 210 Guarding
- Rule 211 Location of Pulleys
- Rule 212 Broken Pulleys
- Rule 213 Pulley Speed
- Rule 214 Belt Guides
- Rule 215 Composition and Wood Pulleys
- Rule 216 Pulleys for Corrosive Conditions
- Rule 217 Pulleys Out of Service

SECTION 22—BELTS AND ROPES

- Rule 220 Horizontal Belts and Ropes
- Rule 221 Vertical and Inclined Belts
- Rule 222 Vertical Belts
- Rule 223 Cone Pulley Belts
- Rule 224 Belt Tighteners
- Rule 225 Guarding Overhead Rope Drives
- Rule 226 Short Drives

SECTION 23—GEARS, SPROCKETS AND CHAINS

- Rule 230 Gears
- Rule 231 Sprockets
- Rule 232 Openings for Oiling

SECTION 24—FRICTION DRIVES

- Rule 240 Guarding

SECTION 25—KEYS, SET SCREWS AND OTHER PROJECTIONS

- Rule 250 Elimination or Guarding

SECTION 26—COLLARS AND COUPLINGS

- Rule 260 Collars
- Rule 261 Couplings

SECTION 27—BEARINGS AND FACILITIES FOR OILING

- Rule 270 Bearings
- Rule 271 Ladders

PART 3—STARTING AND STOPPING DEVICES

SECTION 30—CLUTCHES, CUT OFF COUPLINGS AND CLUTCH PULLEYS

- Rule 300 Guarding

SECTION 31—BELT SHIFTER, CLUTCHES, SHIPPERS, POLES, PERCHES AND FASTENERS

- Rule 310 Belt Shifters
- Rule 311 Belt Shippers and Shipper Poles
- Rule 312 Belt Perches
- Rule 313 Belt Fasteners

PART 4—GUARD STANDARDS

SECTION 40—STANDARD GUARDS (GENERAL REQUIREMENTS)

- Rule 400 Materials
- Rule 401 Design of Guards
- Rule 402 Method of Manufacture

SECTION 41—DISK, SHIELD AND "U" GUARDS

- Rule 410 Disk Guards
- Rule 411 Shield Guards
- Rule 412 "U" Guards

SECTION 42—APPROVED MATERIALS

- Rule 420 Minimum Requirements
- Rule 421 Wood Guards
- Rule 422 Guards for Horizontal Overhead Belts
- Rule 423 Guards for Horizontal Overhead Rope and Chain Drives
- Rule 424 Standard Railings and Toe Boards

PART 5—OPERATING RULES

SECTION 60—CARE OF EQUIPMENT

- Rule 500 General
- Rule 501 Shafting
- Rule 502 Bearings
- Rule 503 Hangers
- Rule 504 Pulleys
- Rule 505 Care of Belts
- Rule 506 Belts on Overhead Pulleys
- Rule 507 Lubrication
- Rule 508 Signals

PART 6—DISCUSSION

Broken Pulleys
 Belt Tighteners
 Metal Belt Lacing
 Power Control

Power Transmission Equipment
 Hand-operated Gear
 Horizontal Overhead Belts
 Drawings

SCOPE

"This code applies to all moving parts of equipment used in the mechanical transmission of power, including Prime Movers, intermediate equipment and driven machines excluding point of operation.

NOTE.—The safeguarding of all connecting rods, cranks, flywheels, shafting, spindles, pulleys, belts, (except flat belts one (1) inch or less in width or round belts one-half ($\frac{1}{2}$) inch or less in diameter), link belts, chains, ropes and rope drives, gears, sprockets, friction drives, cams, couplings, clutches, counterweights, revolving or reciprocating parts, up to but not including point of operation, also all bolts, keys, set screws, oil cups or similar projections, shall be included in and be in accordance with the provisions of the Mechanical Power Transmission Code."

INTERPRETATIONS AND EXCEPTIONS

"The purpose of this code is to provide reasonable safety for life, limb and health. It is the policy of the Department of Labor to liberally construe the rules to secure these results and in all cases of practical difficulty or unnecessary hardship, to grant exceptions from the literal requirements of the code, as long as equivalent protection is thereby secured. When the safeguarding of specific types of machines is covered by other approved codes issued by the Department of Labor, such codes shall be given preference. Where specific devices or methods are mentioned in this code, other devices or methods which will secure equally good results may be used, subject to the approval of the Department of Labor before installation."

Machinery safeguards now in service which are in accordance with previous Department of Labor standards shall be accepted.

These regulations cover the principal features with which power transmission safeguards shall comply. The mere technical fulfillment of these requirements does not assure the approval of the guard if examination shows lack of practicability and durability.

The Department of Labor may require guards not called for in these standards, if, in the opinion of the Department, a sufficient hazard exists to warrant such action.

MANDATORY AND ADVISORY REQUIREMENTS

The word "shall" where used, is to be understood as mandatory and the word "should" as advisory.

Under Chapter 17, Laws of 1918, a fee is charged for the examination of plans, specifications or their equivalent, payable in advance at the time of filing plans and specifications or upon examination of sample equipment:

	Fee
On cost of installation up to \$500.00.....	\$1.00
On cost of installation from \$501.00 to \$1,000.00.....	2.00
On cost of installation over \$1,000.00.....	3.00

In lieu of drawings and specifications of machine guards the Department of Labor requires the installation of sample equipment for examination and approval in each case. The acceptance of sample equipment by the Department of Labor will be sufficient authorization to proceed with the balance of the work.

DEFINITIONS

BELT POLE—A “belt pole” sometimes called a “belt shipper” or “shipper pole”, is a device used in shipping and unshipping of belts to and from pulleys on line or counter shaft where there are no loose pulleys.

BELT SHIFTER—A belt shifter is a device for mechanically shifting a belt from tight to loose pulley or vice-versa, or for shifting belt on cones of speed pulleys.

MAINTENANCE RUNWAY—“Runway” shall mean any permanent runway or platform used for oiling, maintenance, running adjustment or repair work, but not for passage way.

EXPOSED TO CONTACT—The term “Exposed to Contact” shall be interpreted as meaning that the location of an object is such that a person is liable to come into contact with it and be injured.

FLYWHEELS—The term “Flywheel” is to include flywheels, balance wheels and pulleys mounted and revolving on crank shaft of engine or other shafting.

GEARS—A set or train of gears comprises two or more intermeshing gears.

POINT OF OPERATION—Point of operation or feed refers to conditions under which the operator's hands might be cut or crushed while feeding or operating the machine, such as, in case of in-running rolls, rotating or reciprocating knives or cutters, or shearing or crushing action.

PRIME MOVERS—The term “Prime Movers” as used in this code is to include steam, gas, oil, and air engines, motors, steam and hydraulic turbines.

SECURELY FASTENED—The term “securely fastened” shall mean that the safety device or object referred to shall be so secured in place that it cannot be moved under normal or reasonably foreseen conditions or circumstances.

SPROCKETS—A set of sprockets comprises two or more sprockets carrying one or more chains.

PART 1—PRIME MOVERS

SECTION 10—PRIME MOVER GUARDS

Rule 100—Flywheels.

Flywheels located so that any part is six (6) feet or less above floor or platform shall be guarded in one of the following ways:

(a) With an inclosure of sheet, perforated, or expanded metal or woven wire. For standards see Part 4, Sections 40 and 41.

(b) With standard railing placed not less than fifteen (15) inches nor more than twenty (20) inches from rim. When flywheel extends into pit or is within 12 inches of floor a standard toe board shall also be provided. For standards see Part 4, Rule 424.

(c) When the upper rim of flywheel protrudes through a working floor it shall be entirely enclosed or surrounded by a standard railing and toe board.

(d) For flywheels with smooth rims five (5) feet or less in diameter, where the preceding methods cannot be applied, the following may be used: A disk attached to the flywheel in such manner as will cover the spokes of the wheel on the exposed side and present a smooth surface and edge at the same time providing means for periodic inspection. An open space, not exceeding two and one-half ($2\frac{1}{2}$) inches in width may be left between the outside edge of the disk and the rim of the wheel if desired, to facilitate turning the wheel over. Where a disk is used, the keys or other dangerous projection not covered by disk, shall be cut off or covered. See standard for disk guard Part 4, Section 41.

NOTE.—This does not apply to flywheels with solid web centers.

(e) Adjustable guard may be provided at the flywheel of gas or oil engines to be used for starting engine or for running adjustment. A slot opening for jack bar will be permitted.

Rule 101—Crank and Connecting Rods.

Crank and connecting rods, when exposed to contact, shall be guarded in accordance with Part 4, Sections 40 and 41, or by a standard railing as described in Part 4, Rule 424.

Rule 102—Tail Rods or Extension Piston Rods.

Tail rods or extension piston rods shall be guarded in accordance with Part 4, Sections 40 and 42, or by a standard railing on sides and end, with clearance of not less than fifteen (15) inches when rod is fully extended.

Rule 103—Governor Balls.

Governor Balls six (6) feet or less from the floor, or other working level when exposed to contact, shall be provided with an enclosure extending to the top of the governor balls when at their highest position. The material used in the construction of this enclosure shall conform to Part 4, Sections 40 and 42.

PART 2—MECHANICAL POWER TRANSMISSION EQUIPMENT

SECTION 20—SHAFTING

Rule 200—Installation

(a) The diameter of shafting and distance between centers of supporting bearings should be such that the forces acting on the shaft due to belt pulls, thrust of gears, weight of pulleys, gears, etc., will not cause a deflection greater than 1/100 of an inch per foot of distance between the two adjacent bearings.

(b) Each continuous line of shafting shall be secured in position against excessive endwise movement. When line shaft is supported in ball bearings or in surface contact bearings at least two special thrust bearings in the former case, and at least two collars in the latter case, shall be used. In either case the distance between points at which shaft is thus secured should be such as not to allow any excessive thrust or movement as a result of contraction or expansion in length of shaft due to temperature changes.

(c) Inclined and vertical shafts, particularly inclined idler shafts, shall be securely held in position against endwise thrust.

Rule 201—Guarding Horizontal Shafting

(a) All exposed parts of horizontal shafting six (6) feet or less from floor or working platform, excepting runways used exclusively for oiling or running adjustments shall be protected by a stationary casing enclosing shaft completely, or by a trough enclosing sides and top or sides and bottom of shaft, as location requires.

(b) Wherever shafting extends over a drive-way it should be protected as stated above unless it is located fifteen (15) feet or more above drive-way.

(c) Shafting under bench machines shall be enclosed by a stationary casing, or by a trough at sides and top or sides and bottom, as location requires. The sides of the trough shall come within at least six (6) inches of the underside of table, or if shafting is located near floor within six (6) inches of floor. In every case the sides of trough shall extend at least two (2) inches below or above the shaft, as the case may be.

NOTE.—For requirements regarding materials and construction see Part 4, Sections 40 and 42.

Rule 202—Guarding Vertical and Inclined Shafting

Vertical and inclined shafting six (6) feet or less from floor or working platform excepting maintenance runways shall be enclosed with stationary casing in accordance with requirements of Part 4, Sections 40 and 42.

Rule 203—Projecting Shaft Ends

(a) Projecting shaft ends extending more than two (2) inches beyond bearings shall be cut off to present a smooth edge or else be guarded by non-rotating caps or safety sleeves.

(b) Unused key-ways shall be filled up or covered.

Rule 204—Shafting Located in Basements, Etc.

The requirements for safeguarding belts, pulleys and shafting located in basements, towers and rooms used exclusively for power transmission equipment may be waived if the following conditions are met:

1. The basement, tower, or room occupied by transmission equipment shall be locked against unauthorized entrance at all times.
2. The head room should not be less than five (5) feet six (6) inches.
3. The intensity of illumination shall conform to the Code of Lighting for Factories, Mills and other Work Places, issued by the Department of Labor.
4. The footing shall be dry, firm and level.
5. The route followed by the oiler shall be protected in such manner as to prevent accident.

SECTION 21—PULLEYS

Rule 210—Guarding

Pulleys any part of which are six (6) feet or less from the floor or working platform shall be guarded in accordance with the standards

specified under Part 4, Sections 40 and 42. Pulleys serving as balance wheels (e. g. punch presses) on which the point of contact between belt and pulley is more than six (6) feet from the floor or platform may be guarded with a disk covering the spokes. See Part 4, Section 41.

Rule 211—Location of Pulleys

(a) Unless the distance to the nearest fixed pulley, clutch, or hanger exceeds the width of the belt on any fixed pulley, a guide shall be provided to prevent the belt from leaving the pulley on the side where insufficient clearance exists.

(b) Overhanging pulleys, i. e., pulleys on line, jack or counter-shafting where there is no bearing between the pulley and the outer end of the shaft should be provided with a guide to prevent belt from running off the pulley.

(c) For requirements for guarding pulleys located in basements, towers and rooms where no employees are regularly stationed see Part 2, Section 20, Rule 204.

Rule 212—Broken Pulleys

Pulleys with pieces broken out of rims or with cracks, shall not be used.

Rule 213—Pulley Speed

Pulleys operating at a rim speed in excess of 4,000 feet per minute shall be specially designed for the purpose and carefully balanced for the speed at which they are to operate.

Rule 214—Belt Guides

Belt guides shall not be installed except as provided in Rule 211—a and b.

Rule 215—Composition and Wood Pulley

Composition or laminated wood pulleys shall not be installed where they are constantly subjected to the action of moisture.

Rule 216—Pulleys for Corrosive Conditions

Pulleys used where conditions are such as to produce active corrosion should be of corrosion resisting material.

Rule 217—Pulleys Out of Service

Pulleys permanently out of service should be removed from shafting which is in use.

SECTION 22—BELTS AND ROPES

Rule 220—Horizontal Belts and Ropes

(a) Where both runs of horizontal belt are six (6) feet or less from the floor level, the guard shall extend to at least fifteen (15) inches above the belt or to a standard height except that where both runs of a horizontal belt are 42 inches or less from the floor, the belt shall be fully enclosed in accordance with Part 4, Sections 40 and 42.

(b) Overhead horizontal belts, with lower part seven (7) feet or less from the floor or platform, shall be guarded on side and bottom in accordance with Part 4, Section 42, Rule 422.

(c) Horizontal overhead belts more than seven (7) feet above floor or platform shall be guarded under the following conditions:

1. If located over passageways or work place and traveling 1,800 feet or more per minute, and

2. If center to center distance between pulleys is ten feet or more, and
3. If belt is six (6) inches wide or wider.

NOTE.—For details of guard construction and for sizes of materials see Part 4, Section 42, Rule 422 and table on page 26, also Discussion, Part 6.

For guarding of flat belts 1 inch or less in width or round belts $\frac{1}{2}$ inch or less in diameter see "SCOPE".

(d) Where pulleys are of such dimensions and so located as to permit passage of persons between upper and lower run of belt standard railing shall be provided and a substantial passageway, guarded on sides and top, shall be constructed, or space traversed by belt shall be completely barred against passage. This rule does not apply to engine rooms.

In engine rooms a passageway provided with standard railing and toe board will be permitted instead of the above, provided it is used only by engine room attendants.

(e) Horizontal overhead chains and link belt drives are governed by the same rules as overhead horizontal belts and shall be guarded in the same manner as belts.

NOTE.—All guards to be constructed in accordance with specifications under Part 4, Section 42, Rule 423.

(f) American or Continuous System rope drives so located that the condition of the rope (particularly the splice) cannot be constantly and conveniently observed, shall be equipped with a "tell tale" device (electric bell type preferably) that will give warning when rope begins to fray.

Rule 221—Vertical and Inclined Belts

(a) Vertical and inclined Belts shall be enclosed by a guard conforming to standards in Part 4, Sections 40 and 42.

(b) All guards for inclined belts shall be arranged in such a manner that a minimum clearance of six (6) feet six (6) inches is maintained between belt and floor at any point outside of guard.

NOTE.—For guarding of flat belts one inch or less in width or round belts one-half inch or less in diameter see "SCOPE".

Rule 222—Vertical Belts

Vertical Belts running over a lower pulley more than six (6) feet above floor or platform shall be guarded at the bottom in the same manner as horizontal overhead belts if conditions are such as stated in Rule 220—C, 1 and 3.

NOTE.—For guarding of flat belts one (1) inch or less in width or round belts one-half ($\frac{1}{2}$) inch or less in diameter see "SCOPE".

Rule 223—Cone Pulley Belts

A cone pulley drive with all parts of the lower cone pulley three (3) feet or more above the floor need not be guarded provided the belt is equipped with an approved cone belt shifter. Where any part of the lower cone pulley is less than three (3) feet from the floor, the pulley and belt shall be guarded in accordance with Part 4, Sections 40 and 42, and the belt shall be provided with an approved cone belt shifter. See Rule 313.

Rule 224—Belt Tighteners

(a) Suspended counterbalanced tighteners and all parts thereof shall be of substantial construction, and securely fastened. The bearings shall be securely capped. If exposed to contact, means must be provided to prevent tightener from falling.

NOTE.—See "DISCUSSION", Part 6.

(b) Where suspended counterweights are used and not guarded by location they shall be so encased as to prevent accident.

Rule 225—Guarding—Overhead Rope Drives

For guarding of overhead rope drives see Part 4, Section 42, Rule 423.

Rule 226—Short Drives

Short heavy drives with adjustable belt tightener pulleys should be avoided as far as practicable.

SECTION 23—GEARS, SPROCKETS AND CHAINS

Rule 230—Gears

Gears shall be guarded in accordance with the following specifications:

- (a) Complete enclosure of all gears shall be required except as below.
- (b) 1. Gears whose mesh point is less than six (6) feet above the floor or working platform may be guarded with standard guard (See Section 40) to a height of six (6) feet.
- 2. Where the mesh point is six feet or more from the floor or working platform a complete enclosure shall be required.
- (c) A band guard covering face of gear and having flanges extending inward beyond the root of the teeth on the exposed side or sides shall be regarded as a satisfactory enclosure where no spoke hazard exists.

NOTE.—Rule does not apply to hand operated gears used only to adjust machine parts and which do not continue to move after hand power is removed. However, the guarding of these gears is highly recommended. See Part 6, 5.

Rule 231—Sprockets

All sprocket wheels shall be enclosed wherever located and the entire run of chain should be guarded, unless more than seven (7) feet above the floor or platform.

NOTE.—Chains under certain operating conditions constitute a serious hazard. Such chains should be guarded in accordance with standards of Part 4, Sections 40 and 42.

Rule 232—Openings for Oiling.

When frequent oiling must be done small openings with hinged or sliding self-closing covers shall be provided.

SECTION 24—FRICTION DRIVES

Rule 240—Guarding

(a) The contact faces of all friction drives when exposed to contact shall be enclosed.

(b) All arm or spoke friction drives and all web friction drives with holes in the web shall be entirely enclosed.

(c) All projecting bolts on friction drives where exposed to contact shall be guarded.

SECTION 25—KEYS, SET SCREWS AND OTHER PROJECTIONS

Rule 250—Elimination or Guarding

All projecting keys, set screws, and other projections in revolving parts shall be removed or made flush or guarded by metal enclosure. This does not apply to key or set screws within gear or sprocket casings or other enclosures, nor to keys, set screws or oil cups in hubs of pulleys where they are within the plane of the rim of the pulley, except where such pulley is within 36 inches of hanger or bearing.

It is recommended, however, that no projecting set screws or oil cups be used in any revolving pulley or part of machinery even though they are within the limits of the above paragraph.

SECTION 26—COLLARS AND COUPLINGS

Rule 260—Collars

All revolving collars, including split collars, shall be cylindrical and screws or bolts used in collars shall not project beyond the largest periphery of the collar.

Rule 261—Couplings

(a) Shaft couplings shall be so constructed as to present no hazard from bolts, nuts, set screws or revolving surfaces.

Bolts, nuts and set screws will, however, be permitted where they are covered with safety sleeves or where they are used parallel with the shafting and are countersunk or else do not extend beyond the flange of the coupling.

NOTE.—While the use of a rib or clamp type coupling is not recommended it will be acceptable if the ends of the fastenings be well within the periphery of the body of the coupling and the ends of all bolts are flush with or below the crown of the nut. All outside surfaces are to be turned or ground and outside edges carefully rounded.

(b) The shifting part of Jaw clutches, and the shifting or mechanism part of Friction clutch couplings should be attached to the driven shaft, i. e.—the shaft that will be idle when clutch is thrown out of contact.

SECTION 27—BEARINGS AND FACILITIES FOR OILING

Rule 270—Bearings

- (a) Self lubricating bearings are recommended.
- (b) All drip cups and pans shall be safely fastened.

Rule 271—Ladders

Wherever ladders have to be used in oiling shafting, these ladders shall be equipped with shaft hooks at top and/or anti-slip device at bottom.

PART 3—STARTING AND STOPPING DEVICES

SECTION 30—CLUTCHES, CUT-OFF COUPLINGS, CLUTCH PULLEYS, TIGHT AND LOOSE PULLEYS, ETC.

Rule 300

(a) Clutches, cut-off couplings, clutch pulleys, tight and loose pulleys or equivalent means shall be provided in every factory, mill or work-

shop, or sub-division thereof where machinery is used, for the purpose of bringing machines or line shafting, or both, to a prompt stop in case of accident. All controlling mechanism in connection with such devices for machines shall be on or immediately adjacent to such machines, and all controlling mechanism in connection with such devices for controlling line shafting shall be within easy access and shall be so located that it is not necessary to traverse more than 100 feet to reach such control.

(b) Guarding

Clutches, cut-off couplings or clutch pulleys having projecting parts where such clutches are located seven (7) feet or less above the floor or working platform, shall be enclosed by a stationary guard constructed in accordance with these standards. (The "U" type guard is permissible, see Rule 412.)

NOTE 1.—Where clutches, cut-off couplings, or clutch pulleys are so situated within a machine or otherwise guarded by location, the application of this rule is within the discretion of the enforcing officer or body.

NOTE 2.—In engine rooms a standard railing preferably with toe board will be permitted instead of Rule 300-b, provided this room is occupied only by engine room attendants.

(c) Where any of the above mentioned types of clutches are located more than seven (7) feet from floor or working platform and the clearance between the projecting parts of the clutch and the bearing is 18 inches or less, a shield guard should be provided. (See Rule 411.)

SECTION 31—BELT SHIFTERS, CLUTCHES, SHIPPERS, POLES, PERCHES AND FASTENERS

Rule 310—Belt Shifters

(a) Tight and loose pulleys on all new installations shall be equipped with a permanent belt shifter provided with mechanical means to prevent belt from creeping from loose to tight pulley.

NOTE.—It is recommended that old installations be changed to conform to this rule.

(b) Belt shifter and clutch handles shall be located as far as possible from danger of accidental contact and within easy reach of the operator. Where belt shifters are not directly located over a machine or bench, the handles shall be cut off (6) feet six (6) inches, above floor level.

(c) All belt shifters and clutches of the same general type in the shop should move in the same direction to stop machines, i. e., either all *right* or all *left*.

NOTE.—This does not apply to friction on clutch countershaft carrying two clutch pulleys with open and closed belts respectively. In this case the shifter handle has three positions and the machine is at a standstill when clutch handle is in the neutral or center position.

Rule 311—Belt Shippers and Shipper Poles

(a) The use of belt poles as a substitute for mechanical shifters is not recommended. Where necessity compels their use they shall be of sufficient size to enable workmen to grasp them securely. (A two-inch [2"] diameter or 1½" x 2" cross section is suggested.) Poles shall be smooth and preferably of hard wood, straight grain, ash or hickory. The edges of rectangular poles should be bevelled. Poles should extend

from the top of the pulley to within about twenty-four (24) inches of floor or working platform.

Rule 312—Belt Perches

Where loose pulleys or idlers are not practicable, belt perches in form of brackets, rollers, etc., should be used to keep the idle belts away from the shafts. Perches should be substantially made and so designed that the shipping of belts to and from them will be safely accomplished.

Rule 313—Belt Fasteners

Belts which of necessity must be shifted by hand and belts within six (6) feet of the floor or working platform which are not guarded in accordance with the intent of this code shall not be fastened with metal in any case nor with any other fastening which by construction or wear will constitute an accident hazard.

PART 4—GUARD STANDARDS

SECTION 40—STANDARD GUARDS GENERAL REQUIREMENTS

Rule 400—Materials

(a) Standard conditions will be secured by the use of the following materials:

Expanded metal, perforated or solid sheet metal or wire mesh on a frame of angle iron or iron pipe securely fastened to floor or to frame of machine. See Section 42, Rule 402.

(b) All metal shall be free from burrs and sharp edges.

(c) Wire mesh shall be of the type in which the wires are securely fastened at every cross point either by welding, soldering, or galvanizing, except in case of diamond or square wire mesh made of No. 14 gauge wire, $\frac{3}{4}$ " mesh or heavier.

NOTE.—For method of fastening diamond or square wire mesh made of crimped wire into frames, see Rule 402 (3).

Rule 401—Design of Guards

(a) Guards should be preferably provided with hinged sections or be made removable where it is necessary to change belts, make adjustments or for the admission of oil or grease.

(b) Guards should be designed so as not to interfere with the usual machine operations, but give the maximum protection to the operator.

Rule 402—Method of Manufacture

(a) Expanded metal, sheet or perforated metal and wire mesh shall be fastened to frame by one of the following methods:

(1) With rivets or bolts spaced not more than five (5) inches center to center. In case of expanded metal or wire mesh, metal strips, clips or their equivalent are to be used to form a washer for rivets or bolts.

(2) Welding to frame every four (4) inches.

(3) By weaving through channel or angle frame or if No. 14 gauge $\frac{3}{4}$ " mesh or heavier is used by bending entirely around rod frames, see Rule 420, subdivision 3.

- (4) Where openings in pipe railing are to be filled in with expanded metal, wire mesh or sheet metal, the filler material shall be made into panels with rolled edges or bound with "V" or "U" edging of No. 24 gauge or heavier sheet metal fastened to the panels with bolts or rivets spaced not more than five (5) inches center to center. The bound panels shall be fastened to the railing by sheet metal clips spaced not more than five (5) inches center to center.

NOTE.—Diamond or square mesh made of crimped wire fastened into channels, angle or round iron frames, may also be used as a filler in such guards.

Size of mesh shall correspond to table given under Rule 420.

- (5) Where the design of guards requires filler material of greater panel area than 12 square feet additional frame members shall be provided to maintain panel area within this limit.
- (b) All joints of framework shall be made equivalent in strength to the material of the frame.

SECTION 41—DISK, SHIELD AND "U" GUARDS

Rule 410—Disk Guards

(a) A disk guard shall consist of a sheet metal disk not less than No. 22 gauge fastened by "U" bolts or rivets to spokes of pulleys, flywheels or gears. Where possibility of contact with sharp edges of the disk exists the edge shall be rolled or wired.

In all cases the nuts shall be provided with lock washers or their equivalent and be placed on the unexposed side of the wheel.

Rule 411—Shield Guards

(a) A shield guard shall consist of a frame filled in with wire mesh, expanded, perforated or solid metal.

(b) If area of shield does not exceed six (6) square feet the wire mesh or expanded metal may be fastened in a framework of $\frac{3}{8}$ " solid rod, $\frac{3}{4}$ " x $\frac{3}{4}$ " x $\frac{1}{8}$ " angle iron or metal construction of equivalent strength. Metal shields may have edges entirely rolled around a $\frac{3}{8}$ " solid iron rod.

NOTE.—All material of shield guard shall meet the requirements of Section 42, Rule 420.

Rule 412—"U" Guards

"U" Guards should be constructed of materials specified in table, Section 42, Rule 420. Edges shall be smooth and if size of guard requires these edges shall be re-enforced by rolling, wiring, or by binding with angle or flat iron.

SECTION 42—APPROVED MATERIALS

Rule 420—Minimum Requirements

The materials and dimensions specified in this rule shall apply to all guards except horizontal overhead belts, rope, cable or chain guards more than seven (7) feet above floor, or platform. (For the latter, see Table, Page 23.)

TABLE STANDARD MATERIALS AND DIMENSIONS

Material	Clearance from Moving Part at all Points	Largest Mesh or Opening Allowable	Minimum Gauge (U. S. Standard) or Thickness	Min. Height of Guard from Floor or Platform Level
Woven Wire	Under 4"	1/2"	No. 16	6'-0"
	4"-15"	2"	No. 12	5'-0"
Expanded Metal	Under 4"	1/2"	No. 18	6'-0"
	4"-15"	2"	No. 13	5'-0"
Perforated Metal	Under 4"	1/2"	No. 20	6'-0"
	4"-15"	2"	No. 14	5'-0"
Sheet Metal	Under 4"	—	No. 22	6'-0"
	4"-15"	—	No. 22	5'-0"
Wood or Metal Strip Crossed	Under 4"	1/2"	Wood 3/4" Metal No. 16	6'-0"
	4"-15"	2"	Wood 3/4" Metal No. 16	5'-0"
Wood or Metal Strip not crossed	Under 4"	1/2" width	Wood 3/4" Metal No. 16	6'-0"
	4"-15"	1" width	Wood 3/4" Metal No. 16	5'-0"
Stand. Rail	Min. 15" Max. 20"		(See Standard for Railings, Rule 424)	

NOTE.—For flat belts 1" or less in width and round belts 1/2" or less in diameter, see "SCOPE."

(b) Frame Work

- (1) The framework for all guards fastened to floor or working platform and without other support or bracing shall consist of 1 1/2" x 1 1/2" x 1/8" angle iron, metal pipe of 1 1/2" inside diameter or metal construction of equivalent strength. All rectangular guards shall have at least four upright frame members each of which shall be carried to the floor and be secured thereto.

Cylindrical guards shall have at least three supporting members carried to floor.

All guards having framework lighter than the above shall be rigidly braced to some fixed part of machinery or building structure every three feet of their height.

- (2) Minimum dimensions of materials for the framework of all guards except as noted in the following paragraph shall be angle iron 1" x 1" x 1/8", metal pipe of 3/4" inside diameter or metal construction of equivalent strength.
- (3) Guards thirty (30) inches or less in height and not in excess of a total surface area of ten (10) square feet may have a framework of 3/8" solid rod, 3/4" x 3/4" x 1/8" angle or metal construction of equivalent strength.

The filling material shall correspond to the requirements of the table under Rule 420.

NOTE.—This rule is made for the purpose of providing a standard for small guards not subject to severe stress and for use in such locations where guards constructed of framework specified in the above standards would be cumbersome and represent unnecessary expense.

(c) The specifications given in (A) and (B) are the minimum requirements: Where conditions are such that unusual wear or deterioration will be experienced heavier material should be used.

Rule 421—Wood Guards

(a) Wood guards may be used in the woodworking and chemical industries, in industries where the presence of fumes or where manufacturing conditions would cause the rapid deterioration of metal guards. In all other industries, wood guards will not be permitted, except by special permission of the Department of Labor.

NOTE.—A wood guard unless well constructed is not substantial. Wood guards are a decided fire hazard especially when they become saturated with oil and when they are located near flammable material.

(b) Material and Construction

- (1) Wood shall be sound, tough and free from any loose knots.
- (2) Guards shall be made of plain lumber not less than one (1) inch rough board measure and edges and corners rounded off.
- (3) Wood guards shall be securely fastened together with wood screws, hard wood dowel pins, bolts or rivets.
- (4) While no definite dimensions are given under this heading for framework or filler materials, wood guards shall be equal in strength and rigidity to metal guards specified in Rule 420 a, b and c.
- (5) For construction of standard wood railing, see Section 42, Rule 424.

Rule 422—Guards for Horizontal Overhead Belts

(a) Guards for horizontal overhead belts shall run the entire length of the belt and follow the line of the pulley to the ceiling or be carried to the nearest wall thus enclosing the belt effectively. Where belts are so located as to make it impracticable to carry the guard to wall or ceiling, construction of guard shall be such as to enclose completely the top and bottom runs of belt and face of pulleys, see Rule 220—b and c.

(b) The guard and all its supporting members shall be securely fastened to wall or ceiling by gimlet point lag screws, or through bolts. In case of masonry construction expansion bolts shall be used. The use of bolts placed horizontally through floor beams or ceiling rafters is recommended. See tables for sizes of lag screws or bolts, Page 23.

(c) Suitable re-enforcement shall be provided for the ceiling rafters or overhead floor beams where such is necessary to sustain safely the weight and stress likely to be imposed by the guard. The interior surface of all guards, by which is meant the surface of the guard with which a belt will come in contact, shall be smooth and free from all projections of any character, except where construction demands it; protruding shallow round head rivets may be used. All overhead belts, rope, cable or chain drive guards, shall be at least one-quarter wider than the belt or drive they protect, except that such clearance need not exceed six inches on each side.

(d) The table on Page 23 gives sizes of materials to be used and general construction of guards for belts ten (10) inches or more in width. No material for overhead belt guards should be smaller than that specified in table for belts ten (10) to fourteen (14) inches wide

even if the belt is less than the (10) inches. Expanded metal should not be used as a filler in horizontal belt guards on account of the sharp edges of this material.

(e) For clearance between guard and belt rope or chain of various center to center dimensions between the shafts, see bottom of table, Page 23.

Rule 423—Guards for Horizontal Overhead Rope and Chain Drives

Overhead rope and chain drive guard construction shall conform to the rules for overhead belt guard construction or similar width except that the filler material shall be of the solid type as shown in the table. A side guard member of the same solid filling material shall be carried up in a vertical position two (2) inches above the level of the lower run of rope or chain drive and two (2) inches within the periphery of the pulleys which the guard encloses thus forming a trough. These side filler members shall be re-enforced on the edges with $1\frac{1}{2}$ x $\frac{1}{4}$ " flat steel riveted to the filling material at not greater than eight (8) inch centers, the reenforcing strip shall be fastened or bolted to all guard supporting members with at least one $\frac{3}{8}$ " rivet or bolt at each intersection, and the ends shall be secured to the ceiling with lag screws or bolts. The filling material shall be held in place to the framework of the guard and the filler supports by the use of $\frac{3}{16}$ rivets spaced on 4-inch centers. The width of the multiple drive shall be determined by measuring the distance from the outside of the first to the outside of the last rope or chain in the group which the pulley may accommodate.

Rule 424—Standard Railings and Toe Boards

(a) Standard railings shall be forty-two (42) inches in height with mid-rail between top rail and floor.

(b) Posts shall be not more than eight (8) feet apart, they are to be permanent and substantial, smooth and free from protruding nails, bolts and splinters. If made of pipe it shall be one and one-fourth ($1\frac{1}{4}$) inches inside diameter, or larger. If made of metal shapes or bars their sections shall be equal in strength to that of one and one-half ($1\frac{1}{2}$) by one and one-half ($1\frac{1}{2}$) by three-sixteenths ($\frac{3}{16}$) inches angle iron. If made of wood, the posts shall be two (2) by four (4) inches or larger. The upper rail shall be two (2) by four (4) inches, or two one by four (1 x 4) strips, one at the top and one at the side of posts. The mid-rail may be one by four (1 x 4) inches or more. The rails (metal shapes, metal bars, or wood), should be on that side of the posts which gives the best protection and support. Where panels are fitted with expanded metal or wire mesh as noted in tables 420 (a) the middle rails may be omitted.

(c) Standard toe boards shall be six (6) inches high, of wood, metal or of metal grill not exceeding one (1) inch mesh. Toe boards at fly-wheel pits should preferably be placed as close to the edge of the pit as possible.

HORIZONTAL OVERHEAD BELTS, ROPES AND CHAINS 7 FT. OR MORE ABOVE FLOOR OR PLATFORM

WIDTH

Members	Over 10" to 14" inclusive	Over 14" to 24" inclusive	Over 24"	Material
Frame work	1½" x 1½" x ¼"	2" x 2" x 5/16"	3" x 3" x ⅜"	Angle Iron
Filler (Belt Guards)	1½" x 3/16"	2" x 3/16"	2" x 5/16"	Flat Iron
Filler and vertical side member (Rope and Chain Guards)	No. 20 A.W.G.	No. 18 A.W.G.	No. 18 A.W.G.	Solid Sheet Metal
Filler supports	2" x 5/16" flat iron	2" x ⅝" flat iron	2½" x 2½" x ¼" angle	Flat and Angle
Guard supports	2" x 5/16"	2" x ⅝"	2½" x ⅝"	Flat Iron

FASTENINGS

Filler supports to frame work	(2) 5/16"	(2) ⅝"	(3) ½"	Rivets
Filler flats to supports (belt guards)	(1) 5/16"	(1) 5/16"	(2) ⅝"	Flush Rivets
Filler to frame and supports (rope and chain guards)	3/16" rivets spaced	8" centers on sides and 4" centers on bottom.		
Guard supports to frame work	(2) ⅝"	(2) 7/16"	(2) ⅝"	Rivets or bolts
Guard and supports to overhead ceiling	¼" x 3½" lag screws or ½" bolts	⅝" x 4" lag screws or ½" bolts	⅝" ¾" x 6" lag screws or ¾" bolts	Lag screws or bolts

DETAILS—SPACING, ETC.

Width of guards	one-quarter wider than belt rope or chain drive.		
Spacing between filler supports	20" C. to C.	16" C. to C.	16" C. to C.
Spacing between filler flats (belt guards)	2" apart	2½" apart	3" apart
Spacing between guard supports	36" C. to C.	36" C. to C.	36" C. to C.

OTHER BELT GUARD FILLING PERMITTED

Sheet metal fastened as in rope and chain guards,	No. 20 A.W.G.	No. 18 A.W.G.	No. 18 A.W.G.	Solid or perforated
Woven wire 2" mesh	No. 12 A.W.G.	No. 10 A.W.G.	No. 8 A.W.G.	

CLEARANCE FROM OUTSIDE OF BELT, ROPE OR CHAIN TO GUARD

Distance center to center of shafts	Up to 15' inclusive	Over 15' to 25' inclusive	Over 25' to 40' inclusive	Over 40'
Clearance from belt, rope or chain to guard	6"	10"	15"	20"

PART 5—OPERATING RULES

SECTION 60—CARE OF EQUIPMENT

Rule 500—General

All power transmission equipment shall be inspected at intervals not exceeding 60 days and be kept in good working condition at all times.

Rule 501—Shafting

(a) Shafting shall be kept in alignment, free from rust and excess oil or grease.

(b) Where explosives, explosive dusts, flammable vapors or flammable liquids exist the hazard of static sparks from shafting should be carefully considered. Static electricity shall be removed by means of a spring copper brush in contact with the shafting. This brush shall be well grounded through No. 12 insulated copper wire.

Rule 502—Bearings

Bearings shall be kept in alignment and properly adjusted.

Rule 503—Hangers

Hangers shall be inspected to make certain that all supporting bolts and screws are tight and that supports of hanger boxes are adjusted properly.

Rule 504—Pulleys

(a) Pulleys shall be kept in proper alignment to prevent belts from running off.

(b) Both driving and driven pulleys carrying a non-shifting belt should have crowned faces.

(c) Cast iron pulleys should be tested frequently with a hammer to disclose cracks in rim or spokes. It should be borne in mind that the sound is usually much different if the belt is or is not on the pulley.

(d) Split pulleys should be inspected to ascertain if all bolts holding together the sections of the pulley are tight.

Rule 505—Care of Belts

(a) Quarter twist belts when inserted without an idler can be used on drives running in one direction only. They will run off a pulley when direction of pulley is reversed.

(b) Inspection shall be made of belts, lacings and fasteners and such equipment kept in good repair.

(c) Where possible, dressings should not be applied when belt or rope is in motion, but if this is necessary it should be applied where belts or ropes leave pulley not where they approach. The same precautions apply to lubricating chains.

(d) The hazard of static electricity from belts should be carefully considered where explosives, explosive dusts, flammable vapors or flammable liquids exist. Static electricity shall be removed from belts by means of metallic combs the same width as the belt. One comb shall be placed within 10 inches of the line of contact where the belt leaves each pulley or flywheel. These combs shall be in contact with and placed transversely to the belt and shall be well grounded with No. 12 insulated copper wire.

Rule 506—Belts on Overhead Pulleys

A belt pole should be used to throw off or put on belts.

In unshipping a belt it should always be thrown off the driving pulley, not the driven.

It is advisable to have one experienced man to take care of overhead belts and put them on and take them off pulleys.

Rule 507—Lubrication

The regular oilers shall wear tight fitting clothing and should use cans with long spouts to keep their hands out of danger.

Rule 508—Signals

Unless all machinery can be easily seen from its control station, effective signals shall be provided with which to give ample warning before starting machinery.

PART 6—DISCUSSION

1. **BROKEN PULLEYS.** Under Section 21, Rule 212, states that pulleys with small pieces broken out of rim shall not be used. The rough edges formed by pieces broken out of pulley rim offer a decided hazard in case anyone should come in contact with the rough edge of the pulley rim. It also causes considerable unnecessary wear on the belt.

2. **BELT TIGHTENERS.** Under Section 22, Rule 223, states that belt tighteners of the suspended type shall be arranged in such a way as to prevent falling on any person below should the belt break or throw tightener. This can be accomplished by securely fastening cables or chains of sufficient strength to the tightener and to the roof, or some other substantial object above to prevent it from falling far enough to strike a person.

3. **RULE 313** deals with metal belt lacing. This type of lacing when properly installed is smooth, but often, especially in the case of an old belt, the hooks tear out and are likely to injure the operator by catching on body, hair or clothing. There is also danger of the hooks catching in guards or on machine parts if belt tears at joint.

4. **POWER CONTROL.** Among the methods used for power control may be mentioned motor switches, friction clutches, belt shifters and engine stops. The means for controlling power should be positive and should be so arranged that it can be operated from a point not more than 100 feet from any machine drive from the source of power in question. If the stations can be arranged to be within 50 feet of any machine it is highly advisable. There will be cases, as for example, in the steel industry, where a greater distance from the machine becomes necessary.

It is advisable to mark the stop station with a mark easily distinguishable—green bands on posts and green circles on walls are recommended, together with a sign "Stop Station" or "Emergency Stop." A light of characteristic color should be added in shops where night work is carried on.

All electrical devices should operate by the opening of a *normally closed circuit*. Any failure of the current or device will thus be indicated by the stopping of the prime mover. It is advisable to test such devices daily by shutting off the power at noon or night by such means.

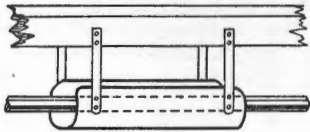
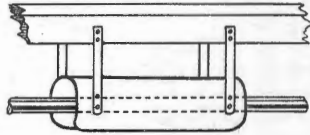
5. POWER TRANSMISSION EQUIPMENT. Rule 204 states certain conditions under which the guarding of power transmission equipment may be modified. This rule was inserted as frequently in paper or saw mills, wood working plants, etc. Transmission equipment is located in basements, lofts or transmission towers not used for any other purpose and it would be a hardship to require the complete guarding of this apparatus.

6. HAND OPERATED GEAR. The note under Rule 230 states that hand operated gears need not be equipped with guards. Quite frequently, however, such gears are operated by a short lever or crank, and when the operator braces himself against the frame of the machine he is likely to come in contact with the gears. It is always good practice to look into this matter carefully and wherever there is the slightest chance of injury it is well to provide guards.

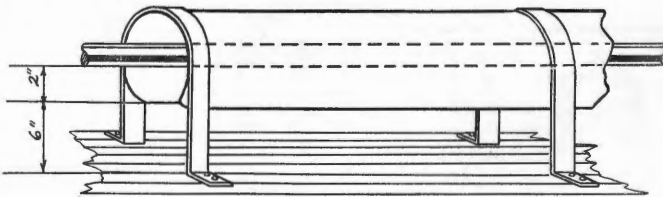
7. HORIZONTAL OVERHEAD BELTS. Rule 220 (c) covers guarding of horizontal overhead belts more than seven (7) feet above floor or platform. It is difficult to decide which overhead belts need guarding and which can be left exposed.

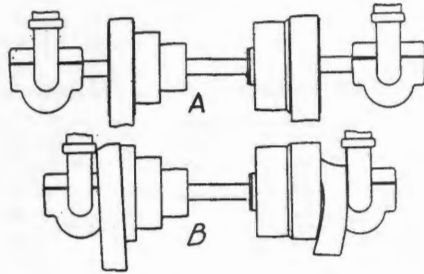
These belts, under certain operating conditions, offer a decided accident hazard in case they break. Any belt transmitting power is subjected to a certain stress which increases with the load and the speed. In case the belt breaks, this force is reduced due to the fact that the driving power is eliminated. The belt is impelled only by its momentum but this is usually sufficient to give it a decided whipping force strong enough to cause considerable damage. This question of overhead belts located more than seven (7) feet above floor or working platform is well worth investigating, as the cost of one serious accident might suffice to pay for quite a number of guards.

TROUGH GUARDS FOR SHAFTING

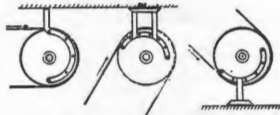


SHAFTING LOCATED UNDER BENCH MACHINES

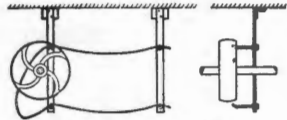




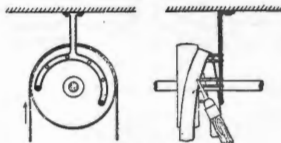
- Showing Proper and Improper Methods of Spacing Pulleys
- A. The Right Way: Countershaft with Spaces Allowed So That if Belts Slip Off They Cannot Wedge and Pull the Countershaft upon Workmen.
 - B. The Wrong Way: Countershaft Showing How Belts May Wedge When They Slip off Pulleys if Insufficient Space is Allowed. This May Result in Injury to Workmen Below.



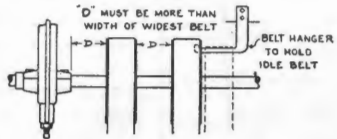
Improved Belt Perches (for Different Positions of Belts)



Belt Perch for Horizontal Belts



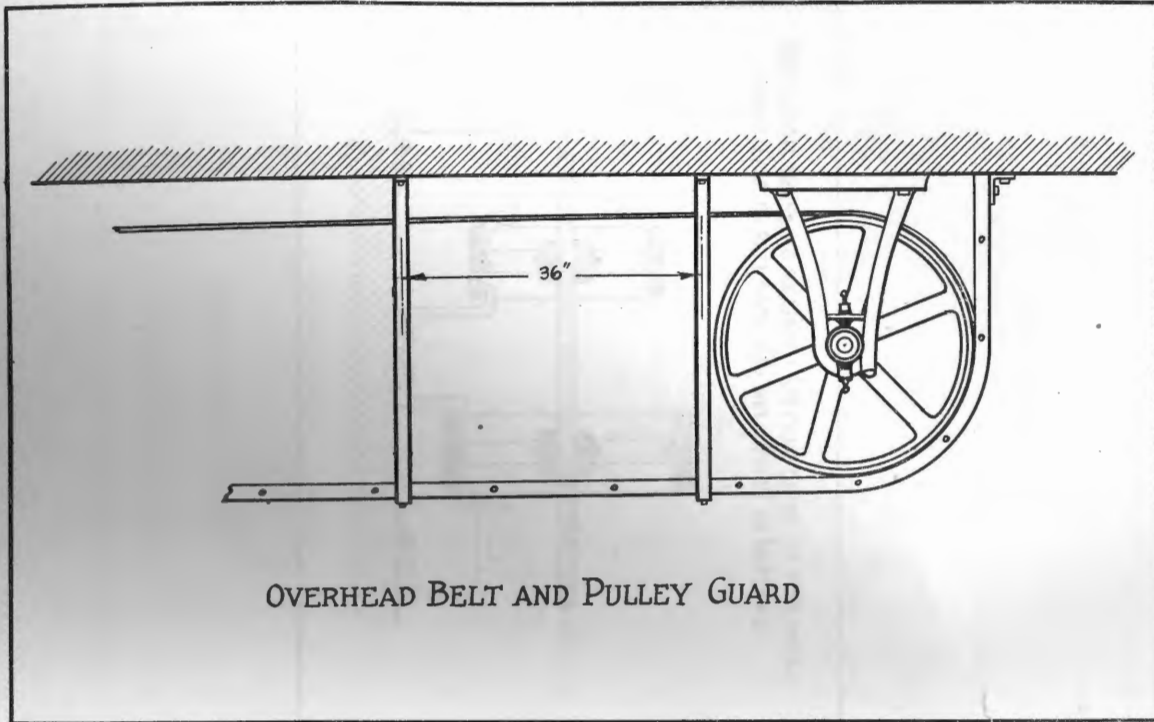
Improved Belt Perch



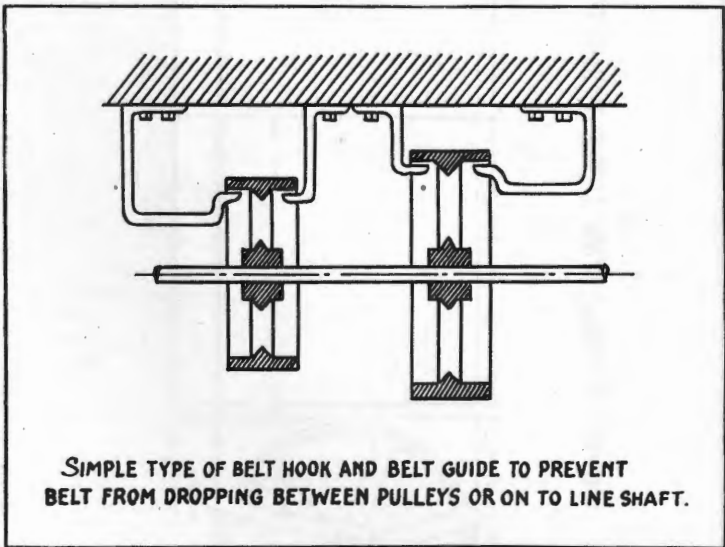
"D" MUST BE MORE THAN WIDTH OF WIDEST BELT

BELT HANGER TO HOLD IDLE BELT

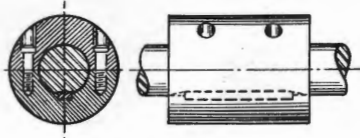
Several Types of Safe Belt Perches



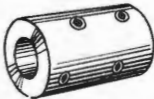
OVERHEAD BELT AND PULLEY GUARD



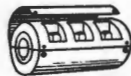
SHAFT COUPLINGS



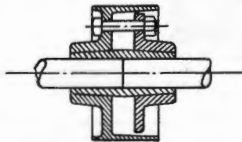
Split Coupling



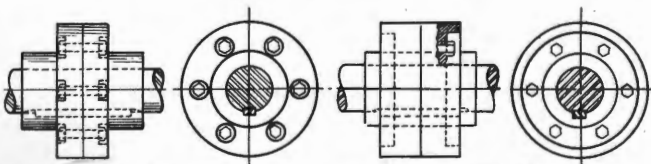
Solid Sleeve Coupling



Clamp Coupling with Safety Sleeve



Compression Type Coupling

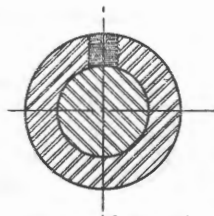
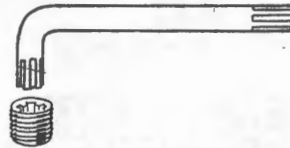
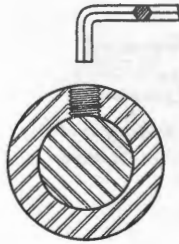


Bolt Heads & Nuts Countersunk.

Flanges Project Beyond Bolt Heads & Nuts.

Flange Couplings

SAFETY SET SCREWS

*Square Head**Slotted Head**Countersunk Heads with Special Wrenches*

NOTE:- To prevent set screws from backing off it has been found good practice to prick punch threads after screw has been tightened. It is also well to spot shaft by means of drill or ordinary casehardened set screw before inserting set screw.

GUARD CONSTRUCTION

