INTER PLANT STANDARD - STEEL INDUSTRY

IPSS	DESIGN CONSIDERATION FOR PROVISION OF SAFETY IN BELT CONVEYOR SYSTEM (*FIRST REVISION*)	IPSS:2-03-003-97
		Formerly: IPSS:2-03-003-85
	Corresponding IS does not exist	

0. FOREWORD

0.1 This Inter Plant Standard, prepared by the Working Group on Conveyors, IPSS 2:3 with the active participation of the representatives of the steel plants, established manufacturers of conveyors and conveyor equipment and reputed consulting organizations, was adopted in May 1997.

0.2 Assistance has been derived from the following publications in the preparation of this Inter Plant Standard:

a) IS 7155:1974 Code of practice for conveyor safety

b) ISO TR:5045-1979 continuous mechanical handling equipment - Safety code for conveyors - Examples of guarding of nip points

c) ANSI A 20.1-1976 Safety standards for conveyors and related equipment, and

d) AS 1755-1975 SAA Conveyor safety code.

1. SCOPE

This Inter Plant Standard covers the factors to be taken into consideration for provision of safety features in belt conveyor systems used in steel plants for conveying loose bulk materials. However, this standard does not cover belt conveyors forming part of machines such as stackers, reclaimers, foundry equipment, etc.

1.1 This standard is intended for ensuring safety to the personnel and safety features of the individual components are only generally covered. The detailed safety features of those components/equipment are to be covered in their individual specification/design codes.

NOTE: The provisions of safety as stated in different IPSS Standards, Indian Standards, statutory regulations, etc shall apply, and have not been included in this Standard.

2. SAFETY PROVISIONS

2.1 The whole conveyor path, especially the loading, unloading and transfer points shall be designed to avoid, as much as possible, all spillage of conveyed material. Zero spillage shall be aimed in places where the conveyor path is passing over areas in the steel plants in which personnel work frequently.

2.1.1 Conveyor belts shall be of sufficient width to suit the designed load requirement for the material to be conveyed. Guiding and centering devices shall be provided for the material at the feed points and along the belt at suitable locations recommended in IPSS:2-03-004-96 `Design parameters for idler sets (*first revision*)'.

2.1.2 In case of inclined conveyors, the slopes and characteristics of conveyors shall be selected so as to avoid slipping and/or dropping of the conveyed product under normal working conditions.

2.2 To prevent running backward/foreward of inclined/declined conveyors respectively, a safety device shall be provided.

2.2.1 Conveyor carrying hot material shall have design features to prevent damage to belt and conveyor equipment during power failure.

2.3 Belt conveyor components shall be suitably guarded. Some guidance in this respect is given in Appendix-A.

2.3.1 Table-1 gives the minimum length of guards which shall be provided to prevent the trapping of fingers or fist into the nip point.

TABLE-1 MINIMUM LENGTHS OF GUARDS

(Clause 2.3.1)

Pulley Diameter, mm	Recommended Distance `a', mm
200	950
315	950
400	950
500	950
630	1000
800	1000
1000	1050
1250	1100
1400	1100
1600	1100
1800	1150
2000	1150

2.4 **Safety Access** - Provision laid down in IS:7155-1974 shall be followed. The design of galleries, tunnels and junction houses shall be in accordance with IPSS:2-03-001-95 `Design parameters for galleries and tunnels for belt conveyors in steel plants (*first revision*)' and IPSS:2-03-002-95 `General design features of junction houses for belt conveyors (*first revision*)'.

2.5 Sharp edges and corners shall be avoided in the working areas between the floor and upto a height of minimum 2 m, normally accessible to maintenance and operation personnel.

2.6 Sequence interlock with safety and monitoring devices shall be provided at every loading point, discharge point, etc, so that no conveyor is able to feed material to a subsequent conveyor or hopper which is inoperative or has reached its full capacity.

2.7 Audible or visual signals shall be provided at suitable intervals along the length of conveyors so that operator is able to give adequate warning to personnel in the vicinity of conveyor installation, about the imminent starting of conveyor system.

2.7.1 In Case of mobile trippers and shuttle conveyors, the area of travel shall be suitably guarded by hand railings and these shall be provided with warning signs and appropriate audio-visual warning system for use before starting the conveyor/tripper.

2.8 **Lighting** - Adequate provision as specified in IPSS:2-03-001-95, IPSS:2-03-002-95, and IPSS:2-03-005-95 `Design consideration for lighting of junction houses, conveyors galleries and tunnels *(first revision)*', shall be provided in galleries, underground construction to the extent possible and in junction houses for natural lighting. For night operations, the lighting arrangements shall conform to IS 3646 (Part 1):1966 `Code of practice for interior illumination: Part-1 Principles of good lighting and aspects of design', IS 3646 (Part 3):1968 `Code of practice for interior illumination: Part 3 calculation of coefficients of utilization by the BZ method' and IPSS *(under preparation)*.

2.9 **Fire protection** - Adequate fire protection facilities such as fire alarms and fire extinguishers shall be provided at all junction houses and at strategic locations in galleries and tunnels.

2.9.1 Fire alarms and fire extinguishers shall be tested regularly and maintained in working condition for use in emergency.

2.10 Adequate ventillation facilities shall be provided to protect men and equipment in accordance with IPSS *(under preparation)*.

2.11 The safe guards for pulleys, wherever provided, shall have opening for lubrication of bearing so that the guards need not be removed for lubrication purposes.

3. SAFETY REQUIREMENTS FOR CONTROL

3.1 All starting and stopping devices shall be clearly indicated and easily accessible and shall be painted on a standard pattern (refer IPSS under preparation).

3.2 Feeding and discharge controls either mechanically or manually operated shall be easily accessible and shall be so placed as to permit supervision of the flow.

3.3 **Pull Cords** - The conveyor system shall be provided with pull cord switches at suitable intervals indicated under clause 3.7.1 along the length of conveyor wherever feasible so that any conveyor in the system may be stopped from any position. In case any sequential operation is intended the conveyor in sequence shall also be stopped.

3.4 Suitable control devices to comply with requirements of 5.3.1 to 5.3.3 and 5.10 of IS:7155-1974 shall be provided on all conveyors.

3.5 Power Isolation

3.5.1 General

3.5.1.1 Provision shall be made for the isolation of each conveyor drive, whether electrical, hydraulic, pneumatic or mechanical.

3.5.1.2 Power isolation shall be obtained by mains supply load break isolation switch(es) or device(s) which shall be capable of being locked in the 'Off' position, preferably by a key and only switched 'On' by manual operation.

3.5.1.3 Features shall be incorporated which clearly indicate the open and closed positions of the isolation means, and also provide a method of preventing unauthorized or inadvertant operation.

3.5.2 **Motor isolation** - Motor isolation shall be obtained by a control circuit isolation device which shall be capable of being locked in the 'Off' position and only switched 'On' by the use of a key, but shall not be capable of being locked in the 'On' position.

NOTE: This does not preclude the use of any other satisfactory method by the Statutory Authority.

3.6 Starting Controls

3.6.1 **Stop control to be combined** - Each starting control shall have combined with it a stopping control. It shall be so situated or guarded that it cannot be started accidentally, and shall be clearly labelled. Where a starting control requires continuous manual pressure to operate the conveyor, it shall be provided with a stopping control adjacent to it.

3.6.2 **Remote control** - Where any conveyor system is equipped with remote control and where there is a separate local manual control switch for any unit in the system, the control shall be clearly marked and so interlocked that local control cannot be over ridden by remote control. In case of stoppage of a particular conveyor in a conveying system, all preceding conveyors shall stop. Conversely for starting a particular conveyor, all subsequent conveyors shall start first in sequence so as to minimize the build up of material at any transfer point.

3.7 Stopping Controls

3.7.1 **General** - The method of stopping the conveyor shall be by stop push button mounted on the control box near the motor and pull cord switches installed along the length of the conveyor and spaced not more than 30 m.

3.7.1.1 The following general requirements apply to stop controls:

a) Stop controls shall be provided in readily accessible positions and at loading and unloading points. All accessible points along the pull cord shall be considered as stop controls. Where, however, a conveyor passes through storage areas, and the like, which are not normally used by personnel, stop controls at the entry and exists of such areas shall be considered to meet the requirements of this clause;

b) The stop control or controls shall be in a normally energized circuit which when interrupted, will cause the conveyor to stop;

c) Any button used for emergency stoppage of the conveyor shall be mushroom head lockable push button types with manual reset, which shall prevent starting of the conveyor from any position until such time as the control operated to stop the conveyor has been reset in the running position. When a push button lock-off stop is used, the stop control shall open the circuit and lock in the off position as nearly simultaneously as possible. The type of stop switch shall be standardized where possible throughout any one system;

d) A conveyor system shall be provided with

i) a common stop control, and
ii) separate stop controls for individual conveyors or groups of conveyors

e) Where access is provided on each side of the conveyor, stop controls that is pull cord switches shall also be provided on each side, and

f) After a conveyor system has been stopped by the operation of any manually operated stop control, it shall not automatically restart upon the resetting of such control. This shall not prevent the restarting of a conveyor after the re-setting of an automatic stopping device. The automatic stopping device shall be labelled to indicate that it may restart the conveyor.

3.7.2 Pull Cord - The following requirements apply to the use of pull cord operated automatic lock-off manual reset stop controls:

a) Where such control is used, the longitudinal pull cord shall be installed on both sides (wherever feasible) of the belt within easy reach of the operator;

b) Except where a stop control complying with 3.7.1 is provided adjacent to the tail end of a conveyor the pull cord switch shall be adjacent thereto;

c) The pull cord should be stranded galvanized or plastic covered steel wire, preferably red in colour or of a similar material not affected by atmospheric dust; and

d) Pull cord supports shall be provided at intervals not less than 2.5 m and not greater than 3 m and located at convenient places.

3.7.3 **Signals** - When a stop control is operated, it shall give an audio-visual signal at the normal (central) control room. This signal shall show the location at which the controller has been operated. On long conveyors, the visual signals shall also be available at the locations of operation of this controller.

3.7.4 Zero speed switch shall be provided to stop the drive pulley in case of jamming of the belt and thus prevent the belt from burning.

3.8 **Interlocking Devices** - Except where the conveyor at the loading and unloading point is operationally visible to and under the control or an operator, electrical and/or mechanical devices shall be provided on all conveyor systems to automatically stop the conveyor or the load when a conveyor, bin, hopper or possible chute also to which feeds, has not been started, has been stopped, or has been blocked with loads so that it cannot receive the additional loads or material.

3.9 **Marking of Controls**

3.9.1 All controls shall be marked with the words appropriate to the function they control, such as stop, start, forward, reverse, raise or lower. Arrows indicating the direction of travel control shall be provided at all forward and reverse controls.

3.9.2 **Location of signs** - Each stop control shall be readily accessible and shall be indicated by a standard or uniform type signs erected in suitably conspicuous positions and shall have letters not less than 15 mm high.

3.9.3 For pull cord controls, signs shall be erected at suitably and clearly visible positions along the length of the conveyor, or at any other location where pull cord is installed, at intervals not greater than 30 m apart and labelled `Conveyor Stop'.

3.10 **Communication** - Suitable means for communication from each conveyor head end and junction tower to various offices shall be provided. For this public address system (speakers at various points with microphones at important locations) may be adopted.

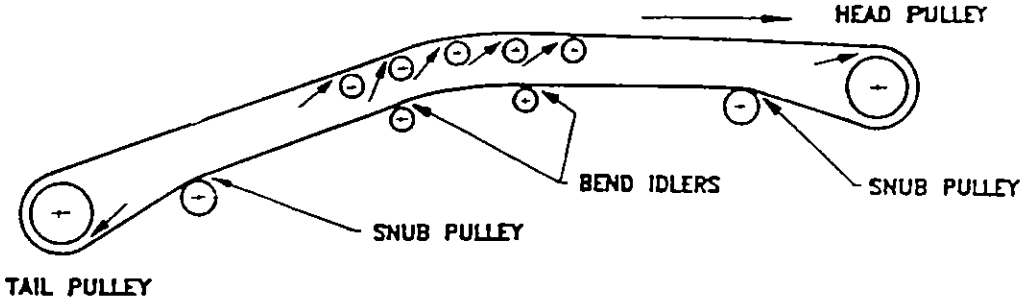


FIG. 1 NIP POINTS ON BELT CONVEYORS

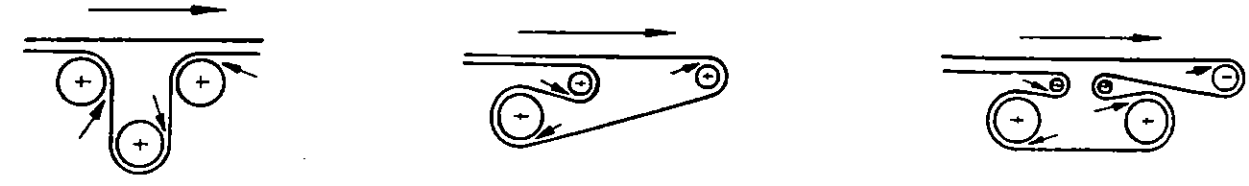


FIG. 2 NIP POINTS TO BE GUARDED AT ADDITIONAL REVERSAL OR DEFELECTION POINTS

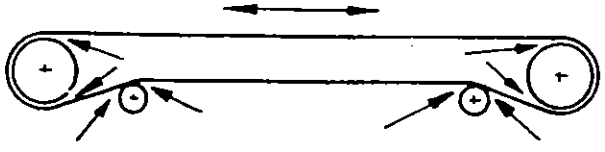


FIG. 3 ADDITIONAL DANGER POINTS IN REVERSIBLE BELTS

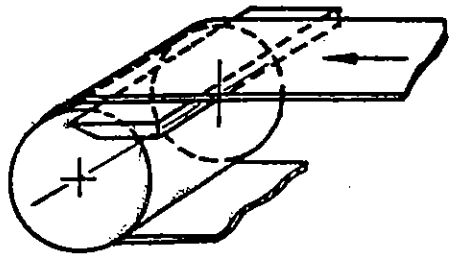


FIG. 4 SOLID PACKING MATERIAL GUARDS

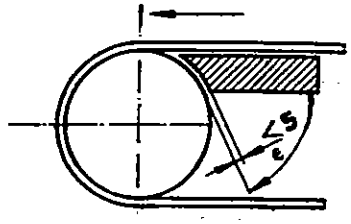


FIG. 5 ANGLE IN SOLID PACKING MATERIAL GUARDS

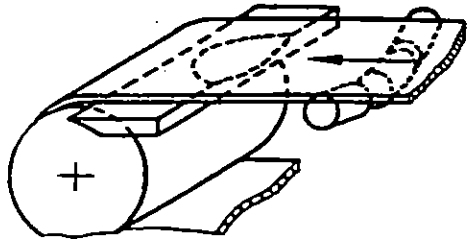


FIG. 6 SHAPING OF UPPER SIDE OF SOLID PACKING MATERIAL GUARDS

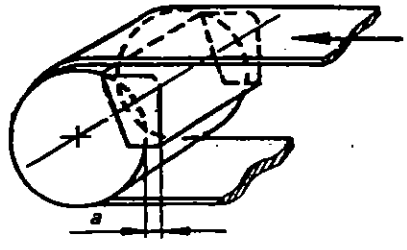


FIG. 7 SHEET METAL GUARD

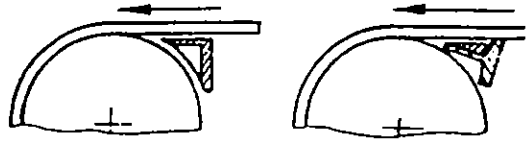


FIG. 8 M. S. SECTION GUARDS

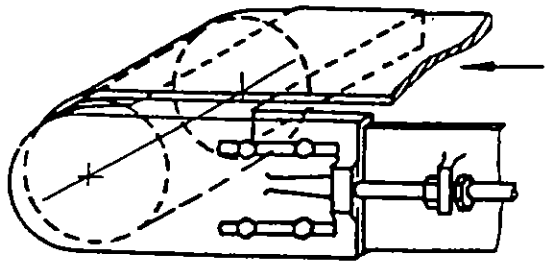


FIG. 9 ENCLOSED TENSION GEAR

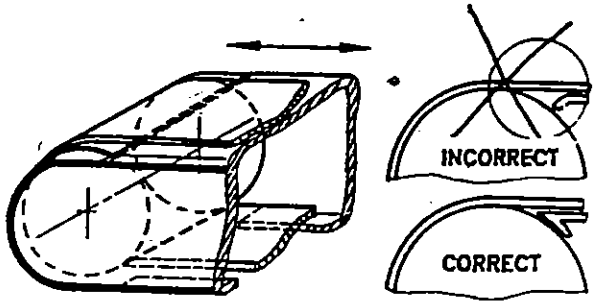


FIG. 10 SLIDING SURFACES

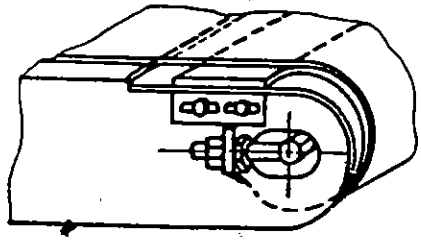


FIG. 11 ADJUSTMENT OF TAKE-UP PULLEYS

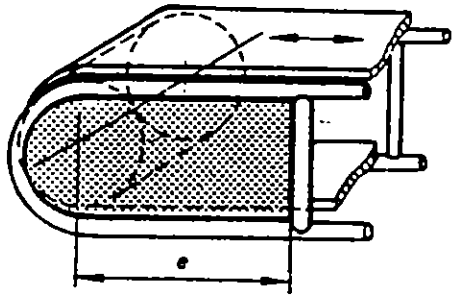


FIG. 12 SIDE COVER BETWEEN STRINGERS

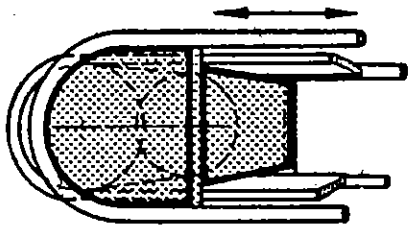


FIG. 13 SHORT SIDE PANELS

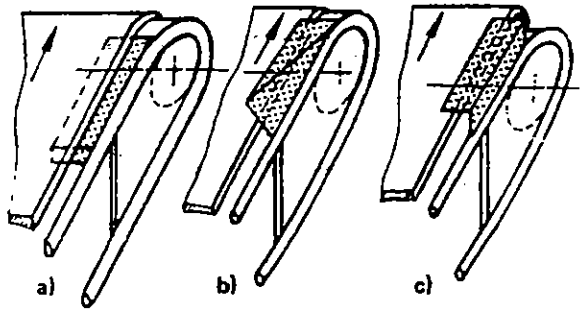


FIG. 14 GUARDS ON UPPER SIDE

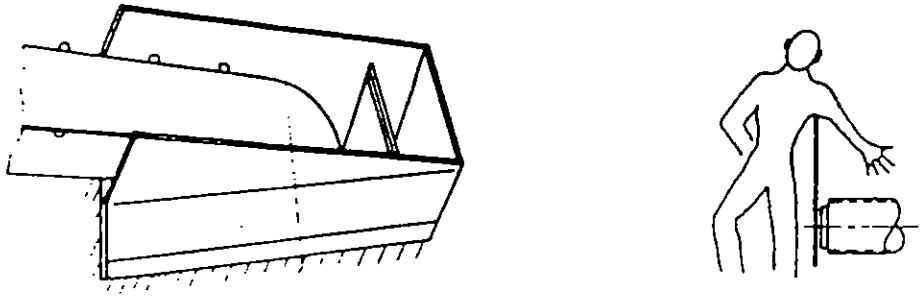


FIG. 15 GUARDS FOR ACCESS FROM SIDE OR TOP

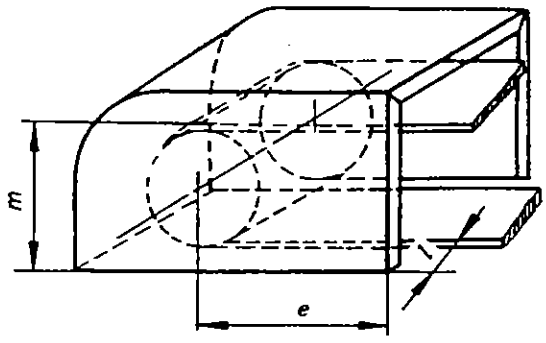


FIG. 16 COVER HOOD

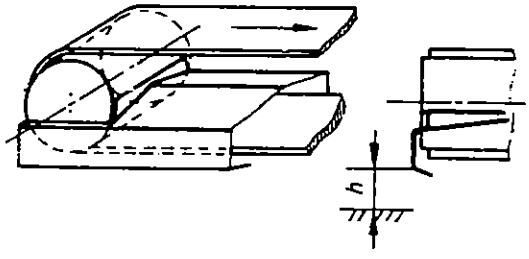


FIG. 17 FIXED GUARDS

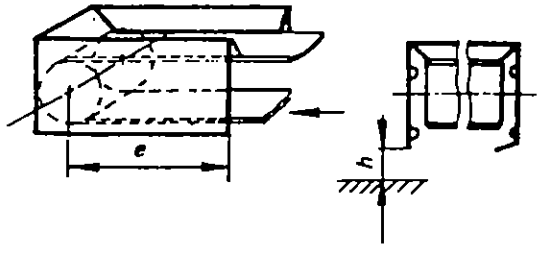


FIG. 18 FEED HOPPERS

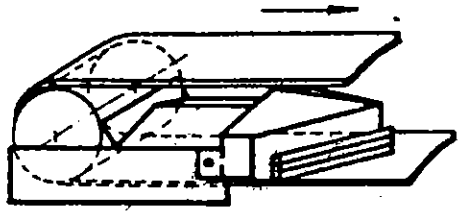


FIG. 19 GUARD COVERING THE RETURN STRAND

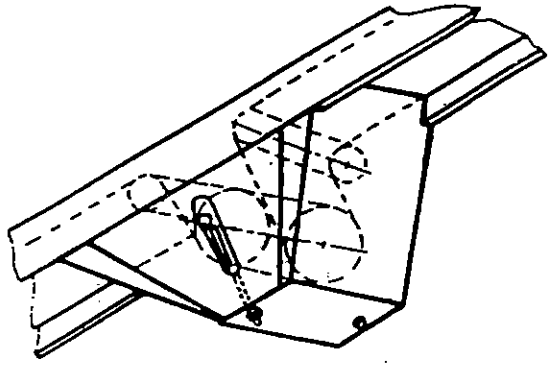


FIG. 20 HOOD ON TAKE-UP PULLEY GUIDE

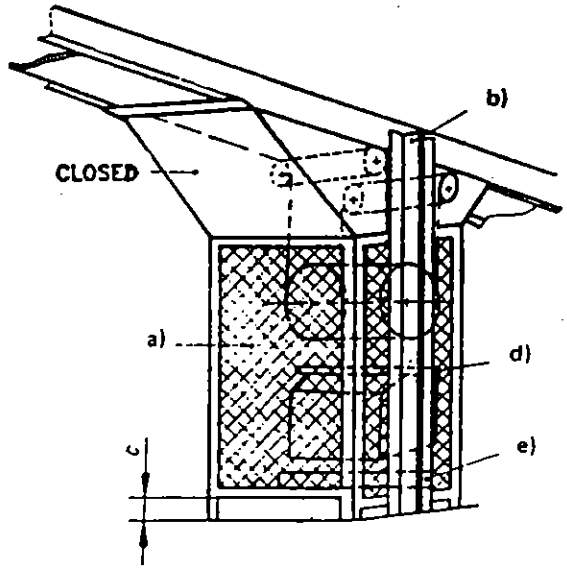


FIG. 21 GUARD FOR A TAKE-UP

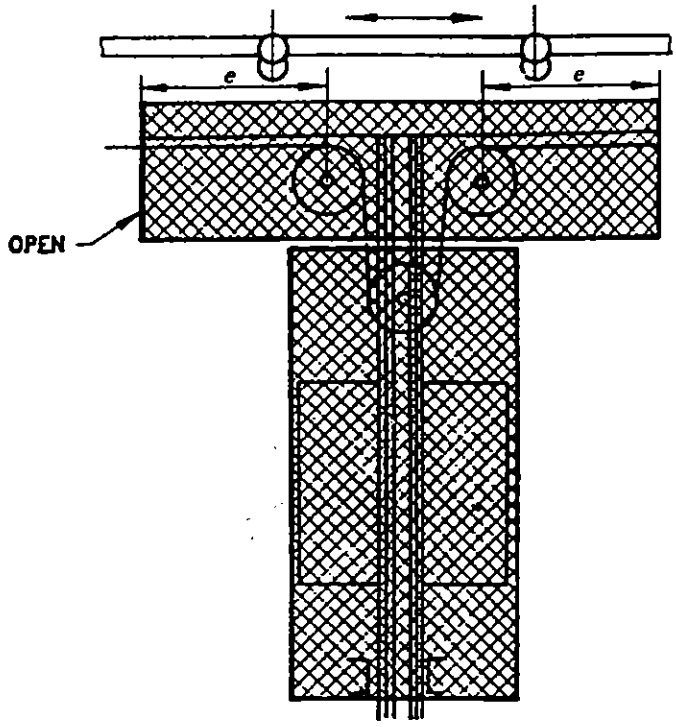


FIG. 22 EDGE OF ENCLOSURE TO PULLEY AXIS

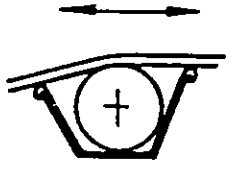


FIG. 23 PULLEY/IDLER GUARD

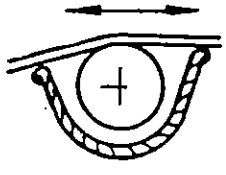


FIG. 24 PULLEY/IDLER GUARD

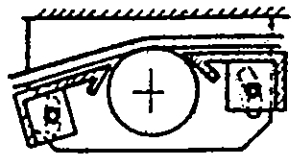


FIG. 25 ADJUSTABLE GUARD

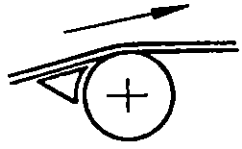


FIG. 26 SOLID ELEMENT

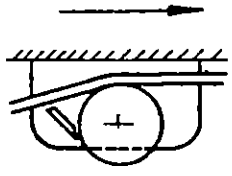


FIG. 27 STRIP GUARD

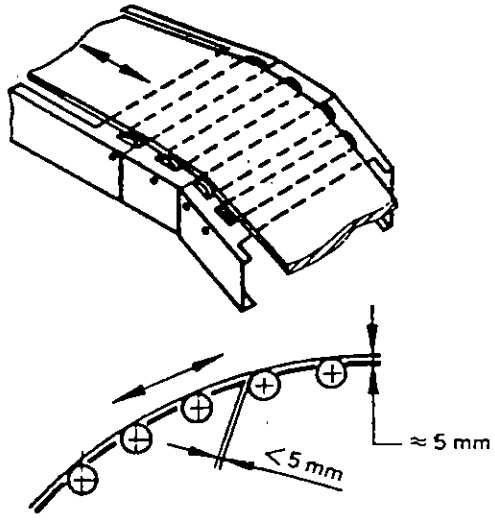


FIG. 28 FILLING IN OPEN SPACE BETWEEN THE IDLERS

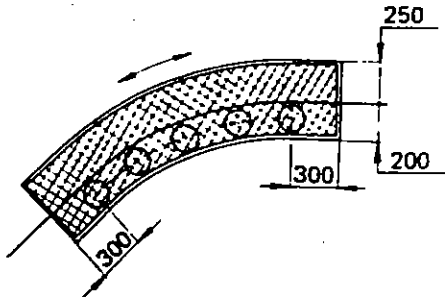
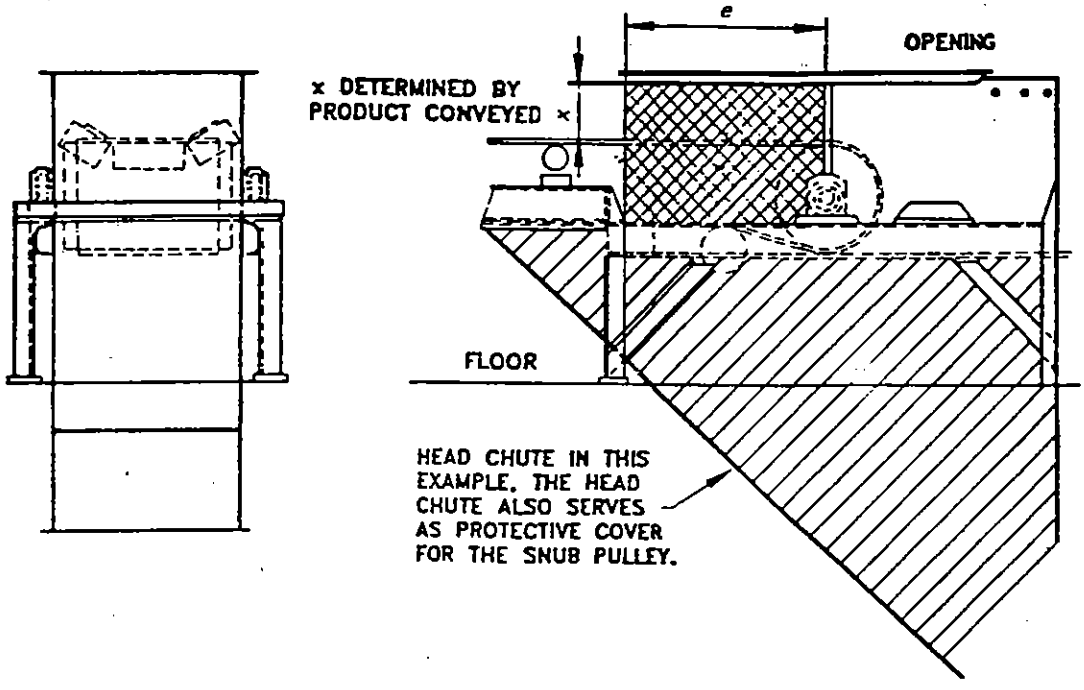


FIG. 29 SIDE PROTECTION COVERS



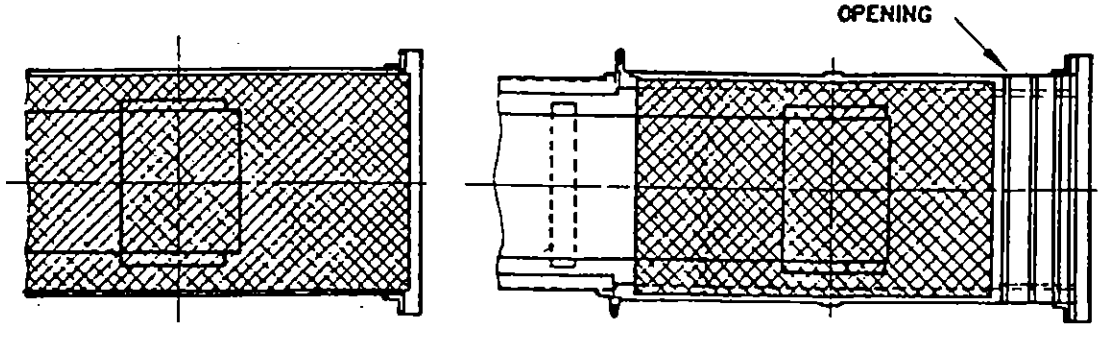


FIG. 30 TYPICAL COMPLETELY ENCLOSED GUARDS

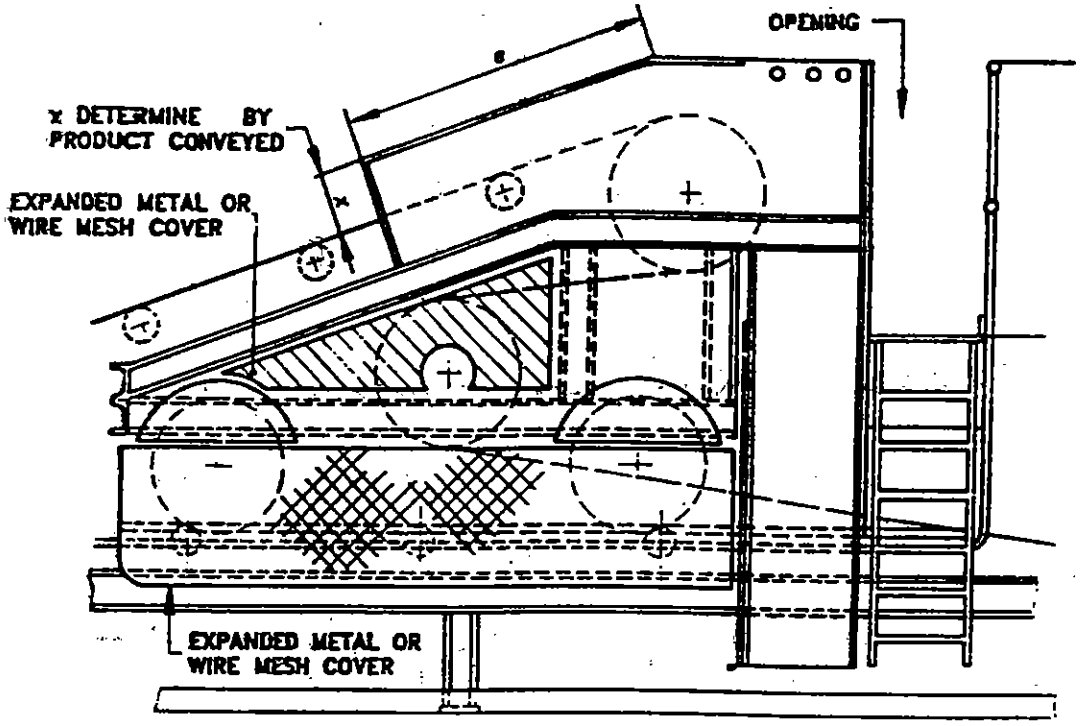


FIG. 31 GUARDING A TRIPPER CARRIAGE

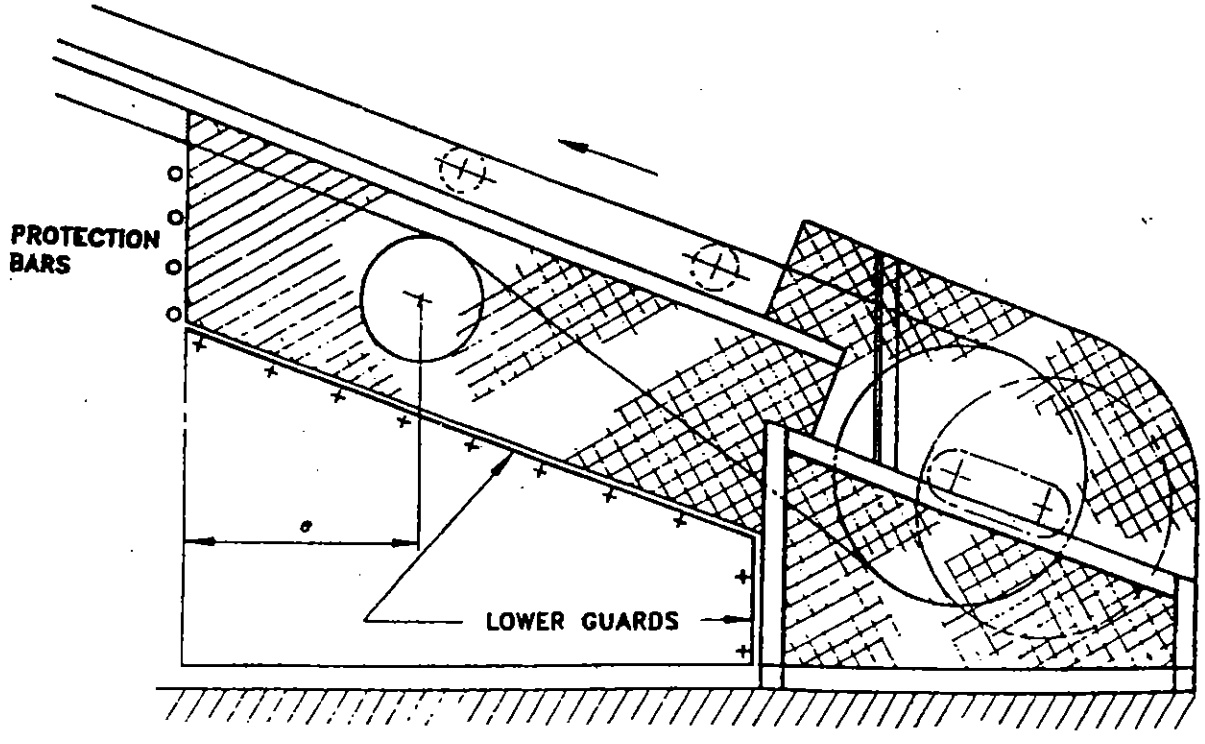


FIG. 32 FULL ENCLOSURE AT THE TAIL END OF A BELT CONVEYOR

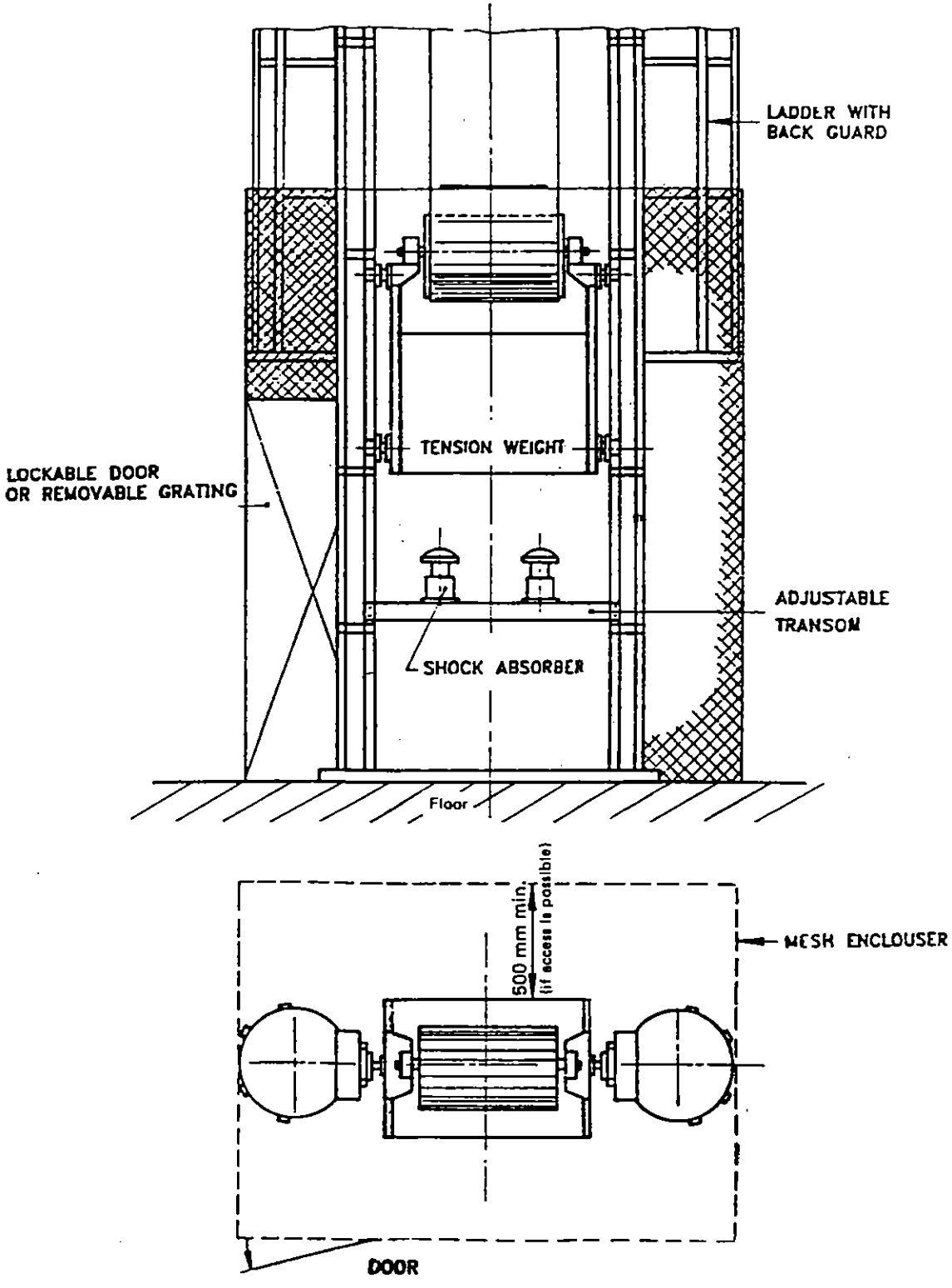


FIG. 33 EXAMPLE OF GUARD FOR GRAVITY TAKE-UP SYSTEM WITH SHOCK ABSORBERS

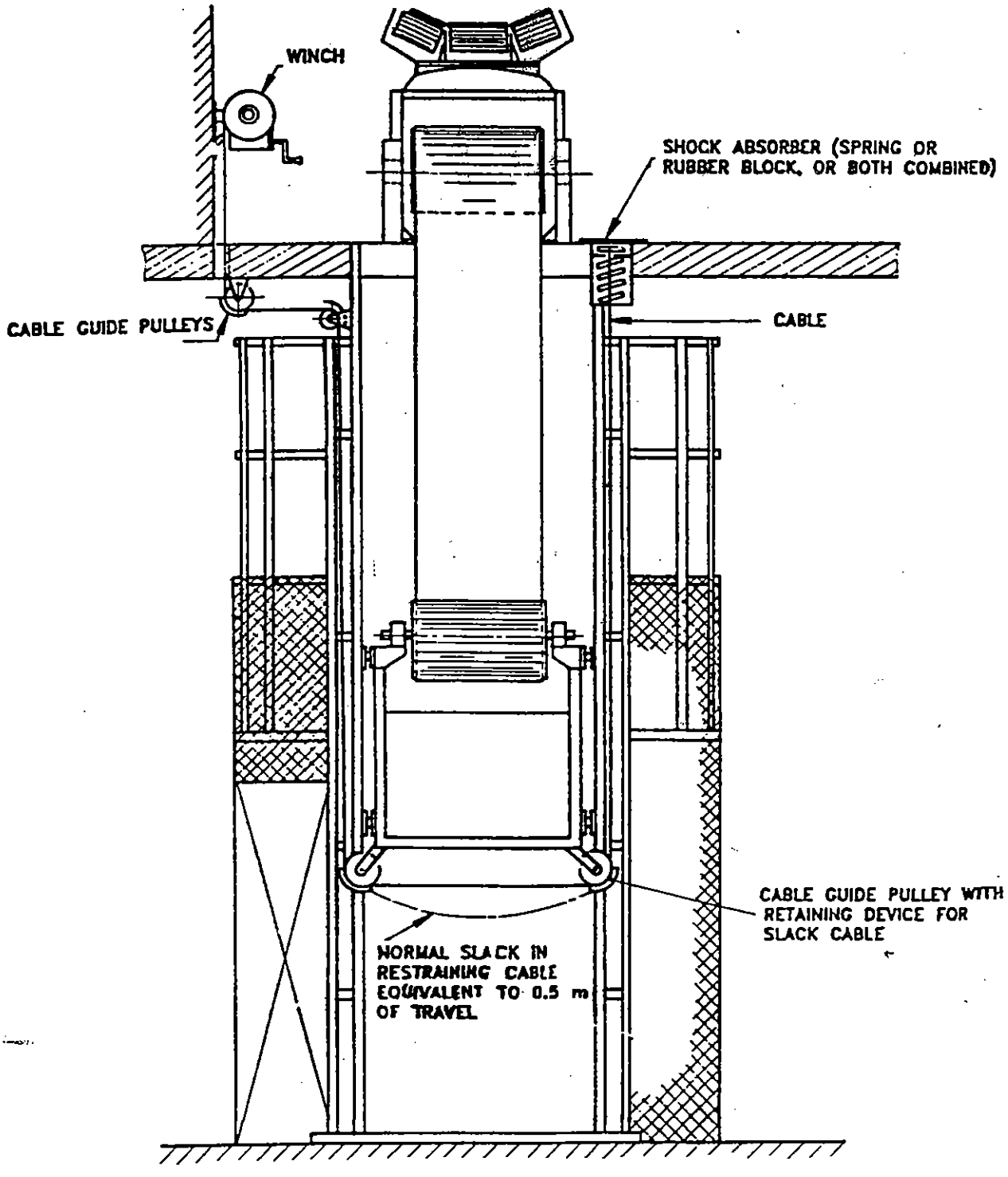


FIG. 34 ANOTHER EXAMPLE OF GUARD FOR GRAVITY TAKE-UP SYSTEM WITH RESTRAINING CABLE