again the advantage of standardizing the grades of materials used for hoisting purposes is an advantage; otherwise the chart would be misleading.

Under no condition should hoisting appliances which are defective or unsafe be allowed to remain within the reach of the workmen. By carelessness or mistake, these may be used in place of perfect ones with serious results in the shape of an accident ensuing. A defective chain, hook, eyebolt, ring or other hoisting appliance should be removed from the shop on the instant of its discovery. In addition, they should be so damaged, if they are impossible of repair, that there is no possibility of a workman using them by mistake. One of the reasons which may tend to prevent enforcement of this rule, is an inadequate supply of slings and other accessories. Unless there are plenty of spare appliances, there may be hesitation in removing a sling from service for the purpose of repairs. It may be retained in use until a more convenient season, but during this interval it may become subjected to a greater strain than it can withstand in its weakened condition, and an accident with possible resultant loss of life may take place.

In the use of chain slings, the workman should be cautioned against striking heavy blows either upon the chain or the hooks to force them into position on the load. These blows are liable to injure the chain and cause a weakness, which will result in its eventual failure. Where multipart slings are used and it is necessary to equalize the length of each part, other material than cast iron should be used for insertion between the links of the chain. Cast iron pieces will break under load and the failure will cause a sudden shock on the chain links which may break or permanently injure it. In the use of wire rope slings, kinks must be avoided. These acutely bend the wires, which bends are suddenly straightened out under load. An excessive strain thereby comes upon the sling and breaks it.

SAFE LOADS FOR ROPES AND CHAINS
(IN POUNDS)

Prepared by National Founders' Association.

CAUTION: When handling molten metal, wire ropes and chains should be 25% stronger than indicated in table.

NOTE. The safe loads in table are for each SINGLE rope or chain. When used double or in other multiples the loads may be increased proportionately.	Dia.	Cir.	When used straight	When used at 60° angle	When used at 45° angle	When used at 30° angle
PLOW STEEL WIRE ROPE	3/8"		1,500	1,275	1,050	750
	1/2		2,400	2,050	1,700	1,200
	5/8		4,000	3,400	2,800	2,000
(6 strands of 19 or 37 wires.)	3/4		6,000	5,100	4,200	3,000
	7/8		8,000	6,800	5,600	4,000
	1		10,000	8,500	7,000	5,000
If crucible steel rope is used reduce loads one-fifth.	1 1/8		13,000	11,000	9,000	6,500
	1 1/4		16,000	13,500	11,000	8,000
	1 3/8		19,000	16,000	13,000	9,500
	1 1/2		22,000	19,000	16,000	11,000
CRANE CHAIN	Dia. of iron					
	1/4"		600	500	425	300
	3/8		1,200	1,025	850	600
(Best Grade of Wrought Iron, Hand-made, Tested, Short Link Chain.)	1/2		2,400	2,050	1,700	1,200
	5/8		4,000	3,400	2,800	2,000
	3/4		5,500	4,700	3,900	2,750
	7/8		7,500	6,400	5,200	3,700
	1		9,500	8,000	6,600	4,700
	1 1/8		12,000	10,200	8,400	6,000
	1 1/4		15,000	12,750	10,500	7,500
	1 3/8		22,000	19,000	16,000	11,000
MANILA ROPE	3/8"	1"	120	100	85	60
	1/2	1 1/2	250	210	175	125
	5/8	2	360	300	250	180
(Best Long Fibre Grade.)	3/4	2 1/4	520	440	360	260
	7/8	2 3/4	620	520	420	300
	1	3	750	625	525	375
	1 1/8	3 1/2	1,000	850	700	500
	1 1/4	3 3/4	1,200	1,025	850	600
	1 1/2	4 1/2	1,600	1,350	1,100	800
	1 3/4	5 1/2	2,100	1,800	1,500	1,050
	2	6	2,800	2,400	2,000	1,400
	2 1/2	7 1/2	4,000	3,400	2,800	2,000
	3	9	6,000	5,100	4,200	3,000

INERTIA EFFECTS IN PIPE-LINES.*

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An extended and detailed study of the conditions to be found in pipes conveying water, when the velocity of flow is changed, has led to the conclusion that there has not been an adequate recognition of the importance of considering the elasticity of both the water and the pipe walls. It has become clear that only by such consideration can correct results be obtained.

It is commonly admitted that the rapidly moving pressure waves set up, when a valve is opened or closed, are annoying and, when excessive, must be taken care of by relief valves, but it is claimed that they have no place in those greater and longer movements which accompany velocity changes. A formula which is often used to calculate these effects ignores the compressibility of the water and the elasticity of the pipe material. It is the purpose of this article to show clearly that this formula is absolutely and unequivocally wrong, has no foundation in fact, and must lead to erroneous results.

At the foundation of all these phenomena is gravity, the manifestation of nature which gives to bodies that quality called weight, which when opposed produces pressure and when unopposed produces movement. Should the opposition decrease, the pressure will decrease and the velocity increase, and vice versâ. This is universal and applies to all ponderable bodies. Such influences as friction, which cause a loss of energy, will modify the results in accordance with their magnitude.

Inertia is that quality of bodies which tends to keep them in a given state of rest or motion unless acted on by some force. A body in motion has energy in proportion to its weight and to the square of its velocity. It is evident, therefore, that to increase the velocity of a body it is necessary to put energy into it, and to decrease it, energy must be taken from it. This act is called overcoming the inertia of a body. It is furthermore true that with a given change of velocity, the amount of energy put in when accelerating will be the same as that taken out when retarding. In other words, acceleration and retardation differ only in direction, the energy change being the same with any given velocity change.

The above remarks are elementary in nature and are introduced solely for the purpose of laying a foundation for what follows.

Consider a pipe-line filled with water under pressure and provided with a valve at the lower end. When the valve is in a closed position the water is compressed and the pipe distended in proportion to the pressure. In this case gravity, being opposed, produces pressure. On

*From Western Engineering, August, 1914.