be injurious to steel elevator buckets. The weight of the bucket, governed by the thickness of its walls, depends nearly entirely upon the weight of the material to be elevated. These definite relationships, and the fact that the capacity of a standard proportioned elevator varies with the size of the buckets employed, permit the expression of the cost of the necessary elevator buckets at so much per foot of elevator, depending upon their size, the weight of material handled and whether of steel or malleable iron construction. The balance of the necessary equipment, consisting of elevator boot, drive, sprockets or pulleys, shafting, bearings, etc., does not vary so much in cost with the load carried as with the size of the buckets—at least, in the ordinary installation. In fact, grouping must again be resorted to, for the cost of these parts does not vary to any great extent for elevators of about the same size—that is, the cost of these parts for 8″ x 5″ elevator would not differ much from the cost of similar parts for a 10″ x 6″ elevator. The average carrying capacity of these two sizes of elevators, however, would vary by nearly 100 per cent. All these relationships and conditions are taken into consideration in the derivation of Formula XIX. and a certain allowance is also made for the cost of the elevator discharge chute, so that the costs obtained through the use of this equation will be found to be approximately accurate in the majority of simple bucket elevator installations. It must be remembered, however, that no allowance is made for an elevator casing and, if such is required, it should be figured upon as an extra item—an item of convenience or safety that does not necessarily affect the economic value of the installation.

Initial Cost:

C = Cost of complete bucket elevator equipment in dollars
H = Height of elevator in feet—distance load is raised.
wl = Size of elevator (buckets) = width x length in inches.
S = Spacing of buckets in inches.
w′ = Weight of material elevated (load) in pounds per cu. ft.

Cost of elevator chains (engineering chain) $= \dfrac{0.00656\ \text{wlH}}{S} \times w'$

(combination chain) $= \dfrac{0.01312\ \text{wlH}}{S} \times w'$

Cost of elevator belts (high grade rubber) $= \dfrac{0.00437\ \text{wlH}}{S} \times w'$

Cost of standard steel elevator buckets $= \dfrac{0.02592\ \text{wlH}}{S} \times w'$

Cost of malleable iron elevator buckets $= \dfrac{0.04493\ \text{wlH}}{S} \times w'$

Cost of boot, drive, pulleys, etc. (D = constant) = Dwl.

Then :—

$$C = \frac{(A + B)\text{wl} \times H \times w'}{S} + \text{Dwl} \qquad \text{Formula XIX.}$$

Where :—
A = Constant = 0.00656—standard detachable chain.
= 0.01312—combination chain.
= 0.00437—high grade rubber belt.
B = Constant = 0.02592—standard steel elevator buckets.
= 0.04493—malleable iron elevator buckets.

SINGLE CHAIN ELEVATORS.

D = Constant = 1.56 when wl does not exceed 24 square inches
= 1.09 when wl exceeds 24 square inches

DOUBLE CHAIN AND BELT ELEVATORS.

D = Constant = 2.01 when wl does not exceed 24 square inches
= 1.40 when wl equals from 30 to 66 square inches
= 1.18 when wl equals from 72 to 96 square inches
= 1.11 when wl exceeds 100 square inches

Assuming that an ordinary installation of bucket is properly cared for and that it is subjected only to the service for which it was designed, Formula XIX. may be greatly simplified and a close approximation of the initial cost of equipment expressed in terms of average tonnage capacity and height of elevator. Such a general equation would not be as accurate for purposes of forming an estimate of the cost of an installation, but is quite accurate enough for purposes of arriving at the probable net operating cost, where the fixed burden of interest on investment, taxes and insurance represents but a comparatively small percentage of the initial cost of equipment. Calculations of depreciation, etc., may be made on such a general equation, for, though depreciation is not constant for elevators subject to all kinds of service or even to average service, the error or increase in depreciation for an elevator handling heavy material would be in large part compensated for by the excess fixed burden charge that would arise from the error in the initial cost, as obtained from the use of such general formula, such initial cost being in excess of the real cost. The expense for power, supplies, etc., being nearly directly proportional to the load handled and height of the elevator and, being a considerable expense in "net operating cost," can be pretty accurately figured and has a marked effect upon the accuracy of Formula XX., by the use of which a conservative and fairly reliable opinion can be formed of the probable net operating cost of any ordinary installation of bucket elevator, knowing the actual cost of power.

Net operating cost (N.O.C.):—
H = Height (distance) through which load is elevated in feet.
= Height of elevator.
W = Weight of load elevated in tons per hour (capacity).

Average cost of equipment :—
= 0.000328 WH + 0.003484 W.

Fixed charges :—

Interest	6% total cost	= 0.000027 WH + 0.000296 W
Insurance	1%	
Taxes	2%—¾ cost	

Depreciation, renewals, etc. :—

On elevator buckets	= 0.000090 WH	
elevator chain or belt	= 0.000012 WH	
balance of equipment	=	0.000523 W
Depreciation account	= 0.000010 WH +	0.000052 W
Total depreciation, etc.	= 0.000112 WH +	0.000575 W

Yearly burden :—
= 0.00014 WH + 0.00087 W

Horsepower, attendance, supplies, etc.:—
P_c = Price (cost) of a horsepower per hour.
N = Number of hours (total) elevator is in use per year.

Cost of power	= 0.0015 WHNP^c	
attendance, etc.	=	0.000075 WHN
supplies, etc.	=	0.000055 WHN

Burden depending on use of elevator = 0 0015 WHNP_c + 0.00013 WHN

Then :—

Net operating cost (N.O.C.) per ton :—

$$\text{N.O.C.} = \frac{112\,H + 575 + (130\,H + 1500\,HP_c)\,N}{1{,}000{,}000\,N} \qquad \text{Formula XX.}$$

Examples:

1. Conditions :—

Material elevated	50′ 0″	= H
Service	2400 hours per year	= N
Cost of power ..	\$0.02 per horsepower per hour	= P_c

$$\text{N.O.C.} = \frac{5600 + 575 + 19200000}{2{,}400{,}000{,}000} = \$0.0080025 \text{ per ton elevated.}$$

2. Conditions :—
The same as in the preceding example except that service is but 1200 hours per year.

$$\text{N.O.C.} = \frac{5600 + 575 + 9600000}{1{,}200{,}000{,}000} = \$0.0080051 \text{ per ton elevated.}$$

Assuming conditions that are common in practice and which may therefore be taken as representative, it will be noted that there is really very little difference in the average net cost of handling material by a bucket elevator whether the installation is in operation a good share of the year or only made use of for half that time. This is due, of course, to the fact that the item of power, etc.,