to run a bucket elevator, the condition upon which the capacity of the apparatus directly depends, is one concerning which there is a great diversity of opinion. It is generally admitted, however, that the most efficient speed for a standard bucket elevator is about the same as that for a flight conveyer handling similar material. Such practice is usually pretty correct and Table X., giving the average actual speed at which a number of very successful and efficient bucket elevator installations are run, confirms the rule.

Table IX.—Capacity of Bucket Elevators (Standard Buckets)—Bushels Per Hour. Elevator Speed, 100 Feet Per Minute.

Size of Buckets	Buckets spaced 12 in.	15 in.	18 in.
5 in. x 4 in.	114	91	76
6 in. x 4 in.	137	110	91
8 in. x 5 in.	335	268	223
9 in. x 5 in.	377	301	251
10 in. x 6 in.	610	487	406
11 in. x 6 in.	671	536	448
12 in. x 6 in.	732	586	488
14 in. x 6 in.	854	684	568
16 in. x 6 in.	976	781	651
18 in. x 6 in.	1098	879	733
20 in. x 6 in.	1220	976	813
14 in. x 8 in.	1393	1104	929
16 in. x 8 in.	1592	1274	1062
18 in. x 8 in.	1791	1433	1194
20 in. x 8 in.	1990	1592	1327
24 in. x 8 in.	2388	1912	1592

In the consumption of power, bucket elevators are not particularly economical or efficient, for not only does the force of gravity act directly against the lift of the load but several other operations consume considerable power. For instance, there is the loss due to the inefficiency of the driving mechanism, comparatively heavy friction losses considering the fact that the number of bearings is quite small in any elevator, owing, in a chain elevator, to the individual friction in each link joint of chain which resists carrying the chain about the end sprockets, etc., and, in the belt elevator, to the unavoidable slippage between the elevator belt and the elevator pulleys, the resistance of the material in the elevator boot to the passage of the buckets through the boot as they pick up their load, etc., etc. There is also, in an inclined elevator, a certain slight consumption of energy in carrying the load from the vertical loading plane to the vertical discharging plane, but this latter requirement of power is actually so slight, as elevators are ordinarily installed, that it can be disregarded. The exact value of these inefficiencies and operations consuming power that is not instrumental in raising the load is difficult to ascertain, and no fixed law for arriving at the correct proportion to allow for such losses of power can be advanced. Manufacturers of bucket elevator equipment usually allow a margin of 50 per cent. to cover all requirements for power other than the theoretical amount that would be actually required to elevate the given load from the point at which it is received (in the elevator boot) to that at which it is discharged (over the head of the elevator). Numerous tests of various installations in actual operation tend to confirm this practice and though the percentages of power losses in various operations do vary considerably their sum is more constant and does actually amount to close to 50 per cent. In the derivation of Formulæ XVII., XVIII-a and b average losses and inefficiencies have been allowed for and the results obtained from the use of any of these formulæ will be found to agree very closely with the actual requirements of the average well-installed and properly cared for standard bucket elevator. Chart IV. presents the same data as the horsepower formulæ in a

Table X.—Efficient Speeds for Bucket Elevators Handling Various Materials.

Material	Advisable Speed
Coke	100 feet per minute
Broken Stone (coarse); Lump Coal—R/M	125 " "
Ashes, Lime and Cement	150 " "
Ore, Crushed Stone, Sand and Gravel	175 " "
Fine Coal	200 " "

convenient graphical form that enables the ascertaining of the power requirements of any ordinary installation to be made rapidly and with sufficient accuracy for practical purposes.

Horsepower:

H = distance through which load is elevated—height of elevator—in feet.
W = Weight of load elevated in tons per hour (capacity).
B = Bushels of load elevated per hour (capacity).
w' = Weight of 1 cubic foot of load in pounds.
b' = Weight of 1 bushel of load in pounds.

$$\frac{W \times 2000 \times H}{60 \times 33000} = \text{horsepower required to elevate load} = \frac{WH}{1000}$$

$$\frac{B \times 1.25\, w' \times H}{60 \times 33000} = \text{" " " "} = \frac{63\, Bw'H}{100{,}000{,}000}$$

$$\frac{B \times b' \times H}{60 \times 33000} = \text{" " " "} = \frac{50\, Bb'H}{100{,}000{,}000}$$

Power loss consumed in running apparatus............ about 17½%
Power loss due to dragging buckets through charged boot 25
Other unavoidable losses 12½

Then,

HORSEPOWER REQUIRED TO OPERATE BUCKET ELEVATOR:—

$$HP = \frac{15\, WH}{10{,}000} \qquad \text{Formula XVII.}$$

$$HP = \frac{95\, Bw'H}{100{,}000{,}000} \qquad \text{Formula XVIII-a.}$$

$$HP = \frac{75\, Bb'H}{100{,}000{,}000} \qquad \text{Formula XVIII b.}$$

Standardization of bucket elevator apparatus facilitates arriving at the cost of the average complete equipment, but the multiplicity of standard types of buckets, chains, etc., varies to a considerable extent the initial cost of even an ordinary installation, necessitating a formula for approximating the cost of equipment a number of constants that differ for the standard component parts of the elevator. However, as this discussion must necessarily be limited to a consideration of general practice and the class of bucket elevator usually found in installations of such character, it is possible to group the apparatus into classes in which exists an approximately constant relationship as to cost. For instance, the chains customarily employed for bucket elevators may be grouped into two classes: one represented by the ordinary detachable link chain, commonly known as the "engineering chain," and the other by the more costly "combination chain," a chain with malleable iron links and steel pins, or by the relatively expensive all-steel link chains, etc. The cost of the chains of both these groups varies closely with their strength or weight, which in turn varies with the load that the elevator is to handle—one group to a greater extent than the other. Practice has also pretty well standardized the spacing of the buckets for any particular size of elevator (size measured by length x width of bucket) so that the load on an elevator can be expressed in terms of size of bucket, height of elevator and weight of the material handled. A similar relationship exists for elevators employing belts instead of chains upon which to carry the buckets. The elevator buckets are usually of steel or of malleable iron, the latter type of bucket being employed when the load to be handled possesses certain chemical properties or is of a temperature that would