

FLUMES AND FLUMING IN THE LUMBERING INDUSTRY

by

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FLUMES AND FLUMING IN THE LUMBER INDUSTRY.

Introduction.

One of the first problems that confronts the logger or mill man today is the transportation of his product. This factor may mean the difference between a paying business and a losing business. The many forms of transportation should be considered before any one is adopted.

When the lumbering industry began in the United States, there were large tracts of timber near the points of consumption or on large streams where the logs could be "driven." Although a very cheap form of transportation, "driving", was in some cases, very wasteful. As the timber along these streams was cut away it became necessary to look for other modes of sending the logs to market. One of these methods was the use of the flume, and it will be the aim of this paper to give the layman a working knowledge of the use, construction, and operation of the flume as applied to the lumbering industry.

Due to the increasing inaccessibility of timber the problem of transportation becomes more and more acute. There are vast areas in the high mountains of the west, both privately owned and in National Forests, that are commercially inaccessible to railroad or truck logging. These areas usually do not have large streams that can be used for driving logs, but most of them have many small streams to use as feeders, and a flume can be operated cheaply enough to return a profit if an up-to-date flume were installed. The chief cost of transportation by flume is the initial cost of building the structure. It must not be overlooked, however, that a flume will transport material in only one direction and all supplies must be hauled to the operation at the head of the flume.

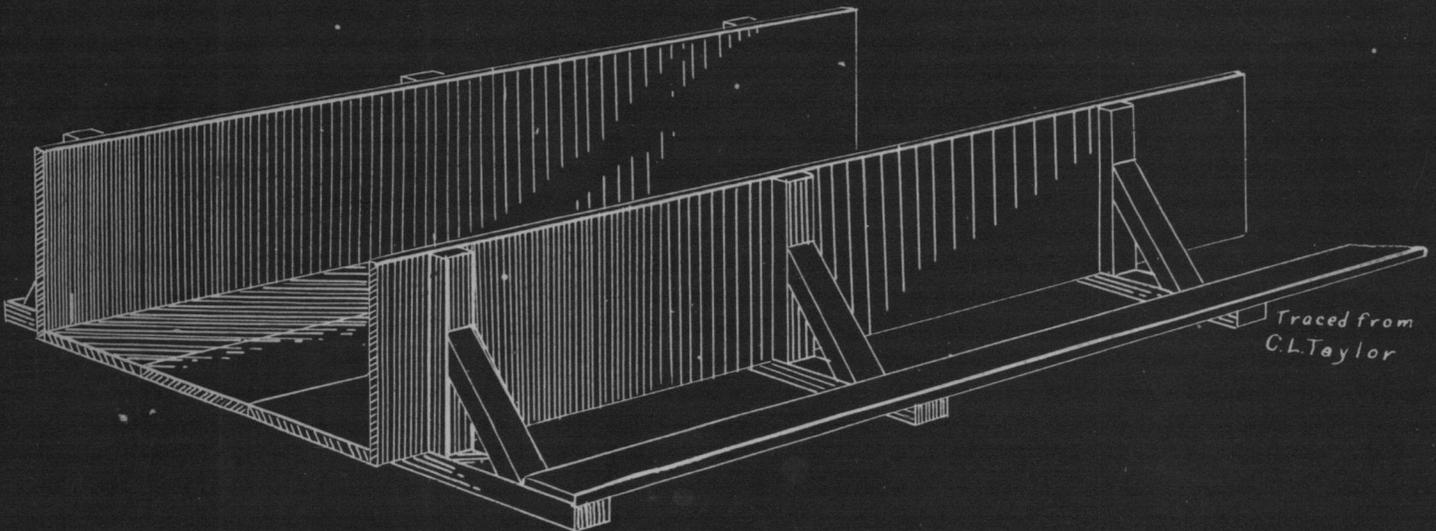
Uses of Flumes:

There are three distinct commercial uses of flumes today in the western United States. These are: (a) for transporting water for power, (b) for transporting water for irrigation, and (c) for transporting lumber and logs. It is the latter use to which this paper is primarily devoted.

The use to which a flume can be put in transporting timber products depends only on the weight of the wood compared with water. The wood must be light enough to float. There are flumes in use in the pine districts of the west for transporting all forms of lumber and logs, such as the full log, piling, mine stulls, fence posts, railroad ties, split logs or "cants," sawed lumber loose or clamped together, cordwood and pulp wood.

The length of flumes varies, as the need requires, from only a few hundred feet to many miles.

Cut No. I



Common Box or Square Flume

N. I

Types of Flumes and Their Place and Use:

There are several factors to consider in deciding the type of flume to build. The first and most important is the supply of water; another is the type of material to be shipped through the flume, and, a third is the length of time the flume is to be in operation.

The supply of water will determine the feasibility of building a flume, the type to use, and to a large extent the profitableness of the enterprise. If the supply of water is large and is being used in volume at the lower end of the flume, a square box type may be used, a drawing of which is shown in cut number I. This flume is merely an open box affair. It has a large water carrying capacity but relatively small log carrying capacity for the amount of water which passes through it. When the water supply is small, this type will not suffice because the water cannot be brought to a high enough level to float the logs. Another disadvantage of the square box flume is that when short material is being shipped through it there is a greater chance for blocking and jamming, because the perpendicular sides catch the material more readily than slooing sides. The amount of lumber required to build the square box of flume is larger than that required for a V shaped flume. The comparative amount of lumber required for the construction of square box and V shaped flumes is shown in the following table.

Timber required for 100 feet of flume box with capacity of handling 32-inch logs.

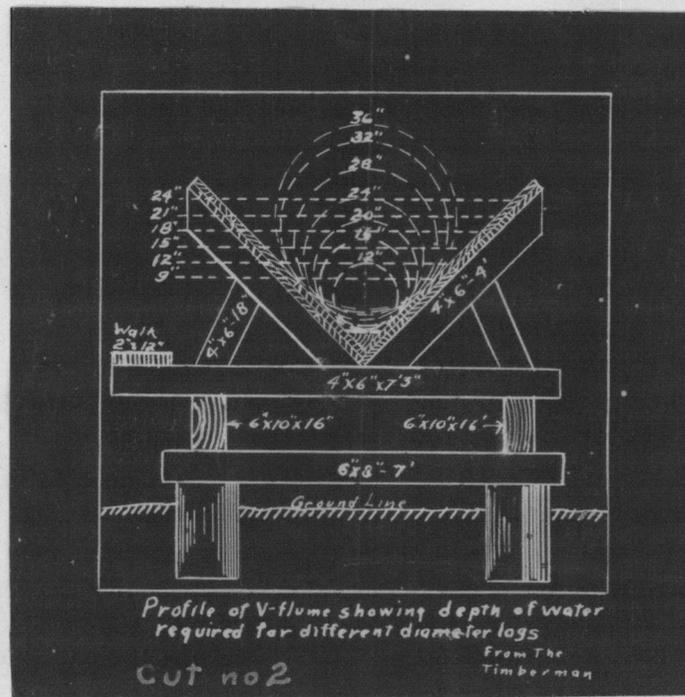
V Shaped Flumes				Square box Flume		
Piece.	Size	Bd Ft Piece	Total	Size	Bd Ft Piece	Total
bracket sill	3"X6"X4'6"	6.75	168.80	3"X6"X5'10"	8.75	218.60
battens	1"X4"X4'	1.33	166.25	1"X4"X4'	1.33	232.75
braces	2"X6"X1'2"	1.17	58.50	2"X6"X1'5"	1.42	71.00
arms	2"X6"X2'4"	2.33	116.50	2"X6"X1'8"	1.66	83.00
box lining#	1½"X58"X16'	116.00	725.00	1½"X77"X16'	153.92	962.00
			<u>1235.05</u>			<u>1567.35</u>

In table: Using total width of boards in box.

The table shows the difference in amount of lumber used in the construction of the B shaped flume to be 79% as much as is used in square box flume of the same capacity.

The advantages of the V shaped flume over the square box type, other than the material saved in building, will be taken up and discussed separately.

Cut No. 2



(a) Large capacity when compared with the square box type with a given amount of water.

The size of logs that can be transported with given depth of water in a V shaped box is shown in cut No. 2. These same logs could be floated in a square box with the same depth of water but would require twice as much water to get the same depth. In this connection the V shaped flume has the advantage, as the log shape fits into the V, and, if it rests on the bottom of the box, blocks the water which piles up behind the log, and runs around its sides which in turn tends to raise it and move it along.

(b) Less Jamming.

The fact that the sides are sloping, forming a narrower channel, keeps the material from becoming cross braced as is likely to happen in the square box type. This is especially true when short material is being shipped.

(c) Less Joints.

The shape of the V type of flume eliminates one corner which in turn reduces the chances of leakage. Leakage is especially bad if the flume is left dry for a short time. The one less corner cuts the chances for leakage in half in the V shaped flume and thereby reduces maintenance cost.

Metal Flumes.

The metal flume has not come into use in the lumbering industry but is used for transporting water for hydro-electric power and for irrigation. It is believed by several writers that with the increasing use of flumes for transporting logs and lumber the metal flume will come into use. The metal flume is semi-circular in shape. This one feature is very desirable for log transportation as, by conforming to the shape of the log, it tends to utilize small amounts of water to the fullest extent. Other advantages of the metal flume are: (a) It can be put up and taken down readily, because of its construction. The sections are clamped to each other, making it very simple to put together and dismantle. (b) The smooth sides practically eliminate any chance for jams as the ends of the material have nothing to butt against. (c) The long life of the metal flume is a very attractive factor in its favor. If the operation requires changes in location, the sections can be unclamped and moved from place to place.

While these advantages can be set down as being worthy of mention, it is well to look also at the disadvantages encountered. The most striking disadvantage to be found with the metal flume is that of

initial cost. It would cost more to buy the metal sections and transport them to the place where they are to be used than it would to build a wooden flume. The item of transportation is important. While the metal flume is being constructed it would be necessary to haul or pack it to the flume location. The method of handling the wooden material will be discussed under the head of construction.

Planning The Flume Location.

The first thing to do after it is decided to construct a flume is to make a reconnoissance survey to determine its general location. This survey will be very rough since nothing will be necessary but a general idea of the topography of the country, the salient points and their differences in elevation.

After the reconnoissance survey has been made, a careful and accurate preliminary line should be run. The "P" line survey is of great importance and should be run with comparative accuracy, but not with too much useless expense.

With the data obtained from the preliminary survey it is possible to estimate to a relatively close amount the final cost of the flume. The importance of this estimate is readily seen. If the estimated cost of building the flume is so great as to be unprofitable the operation can be discontinued and no more money put into the venture. This one feature alone is well worth the price of the preliminary survey, as it gives the operator a relatively high assurance that he is not going into a losing game.

A Profile map of the line is very desirable and advisable. From this map it is possible to determine the grade that can be used and also the extent and degree of curves necessary on the line. From the map a paper location can be made which will aid greatly in running the final location in the field.

Grades and Curves.

The ideal situation would be to have an absolutely straight flume with an even grade. This ideal is never reached in a long flume; it is, therefore, necessary to know the fundamentals governing curves and grade changes.

It is of utmost importance that when long timbers are to be shipped, sharp curves and abrupt grade changes be avoided. It is readily seen that a long log will not pass around a curve as easily as it will go along a tangent. If the curve is too sharp, the log will either jam and block the flume or the ends will climb the outer side and it will fall out. A sharp curve will have a tendency to spill water unless the outer side is higher, even when short material is sent thru it. It is advisable to blast out points or even tunnel short distances to avoid a sharp curve or breaks in grade.

It is important to avoid abrupt or extreme changes in grade as these conditions will have a detrimental effect on the flume. If the grade changes abruptly there will be a decided dragging of the log on the bottom at the point of change. This can be avoided to an appreciable degree by putting in a long vertical curve. The amount of water in the flume should be increased if possible at the beginning of this curve in order to give more depth. As the water begins to run down the steeper slope, it will travel faster and therefore have less depth, which will cause the log to drag on the bottom and wear the flume box much faster than if it can be made to float. The effect of the log on the flume when coming from a steep slope to a gentle one is one is also detrimental if the change is not very gradual. The log coming down the steep slope will hit the bottom with a jarring effect and in only a short time will cause leaks which are an expensive item in flume operation.

The lowest advisable grade is 1% and it should be kept below 15%. Flumes have been operated with fair satisfaction up to 66% but, in such cases, are wet slides rather than true flumes. The log slides down the slope on which water is flowing. The most successful grade to use is between 2% and 5%.

The amount of curvature that can be used is determined by the length of the material to be shipped, but it should never be shorter than a 20 degree curve for satisfactory operation and should be kept lower if possible. Under no circumstances should the curve be so sharp that it will cause the material to bind.

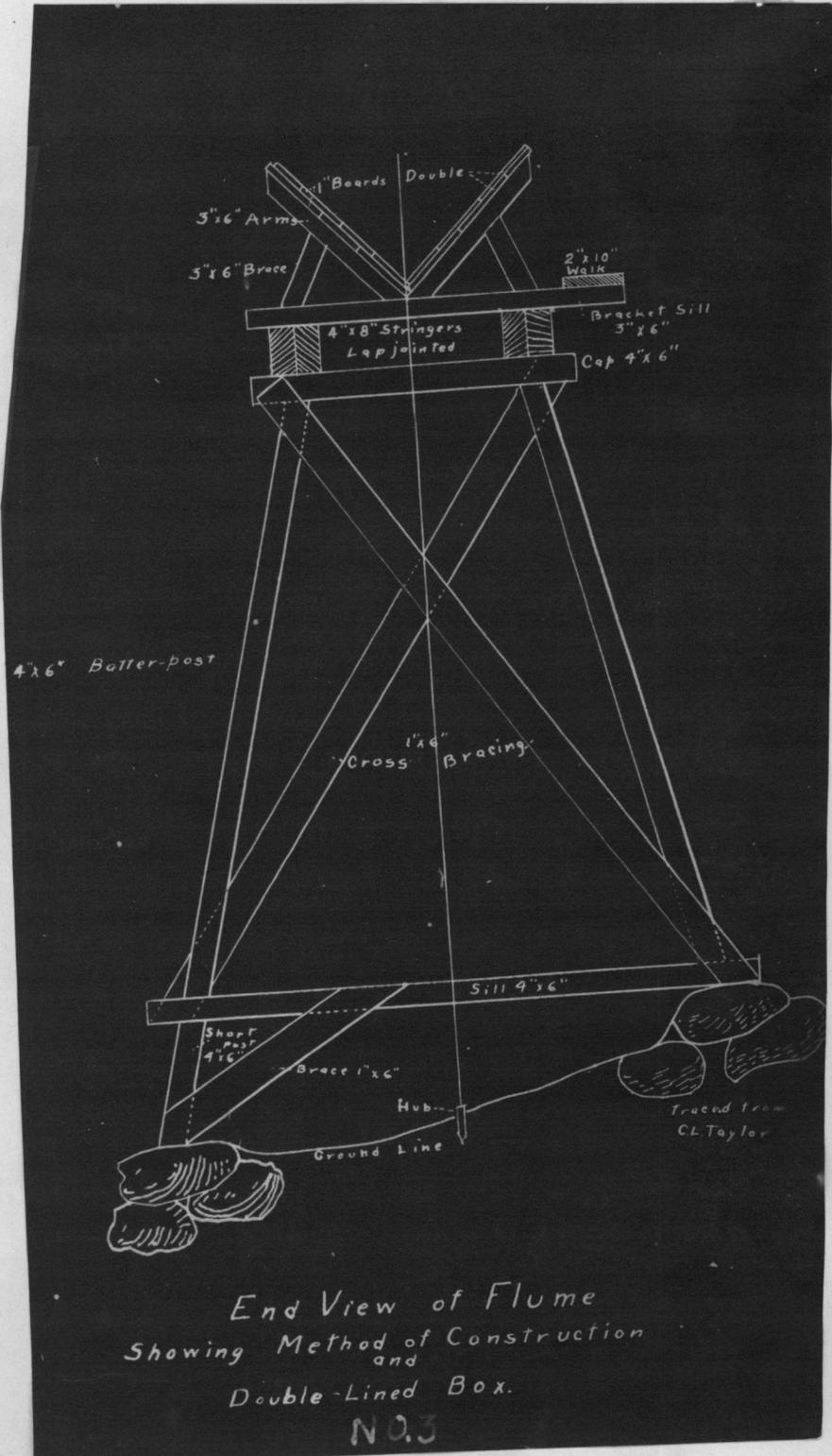
Another effect of short curves, even when short material is shipped, it throws the water and load against the outside edge, tending to wear it much faster than the other side or on the straight line. The throwing of the material to one side also has a straining effect on the trestle, making it necessary to put extra bracing on at this point. Repeated jams on short curves will eventually break down the trestling, which will necessitate rebuilding or repairing and is of course an added expense.

An even curve is as essential as a long curve. This can be accomplished by using short boxes at these points. As stated in U.S.D.A. Bulletin 87, it is best to have boxes of a V shaped flume on a 6 to 10 degree curve joined at least every 12 feet and, still better, every 10 feet, or a 10 to 15 degree curve every 10 feet, and above 15 degrees, every eight feet.

It is best to spend a little more money for grading or trestling than to put in a curve if it can be eliminated in this way. The sides should be built a little higher on curves to keep water from slopping over and to force material back into the flume when it starts to climb, as it always does. To increase the height of the sides, it is only necessary to use a little longer arms and a rough lining to bring them to the desired height.

Tunnelling, grading, and trestling have been mentioned to some extent in discussing curves and grades. The method of obtaining even grades and eliminating curves by trestling, is perhaps the most used in constructing flumes. The cost of a low trestle is much less than grading and is much more satisfactory. Trestles may be built across

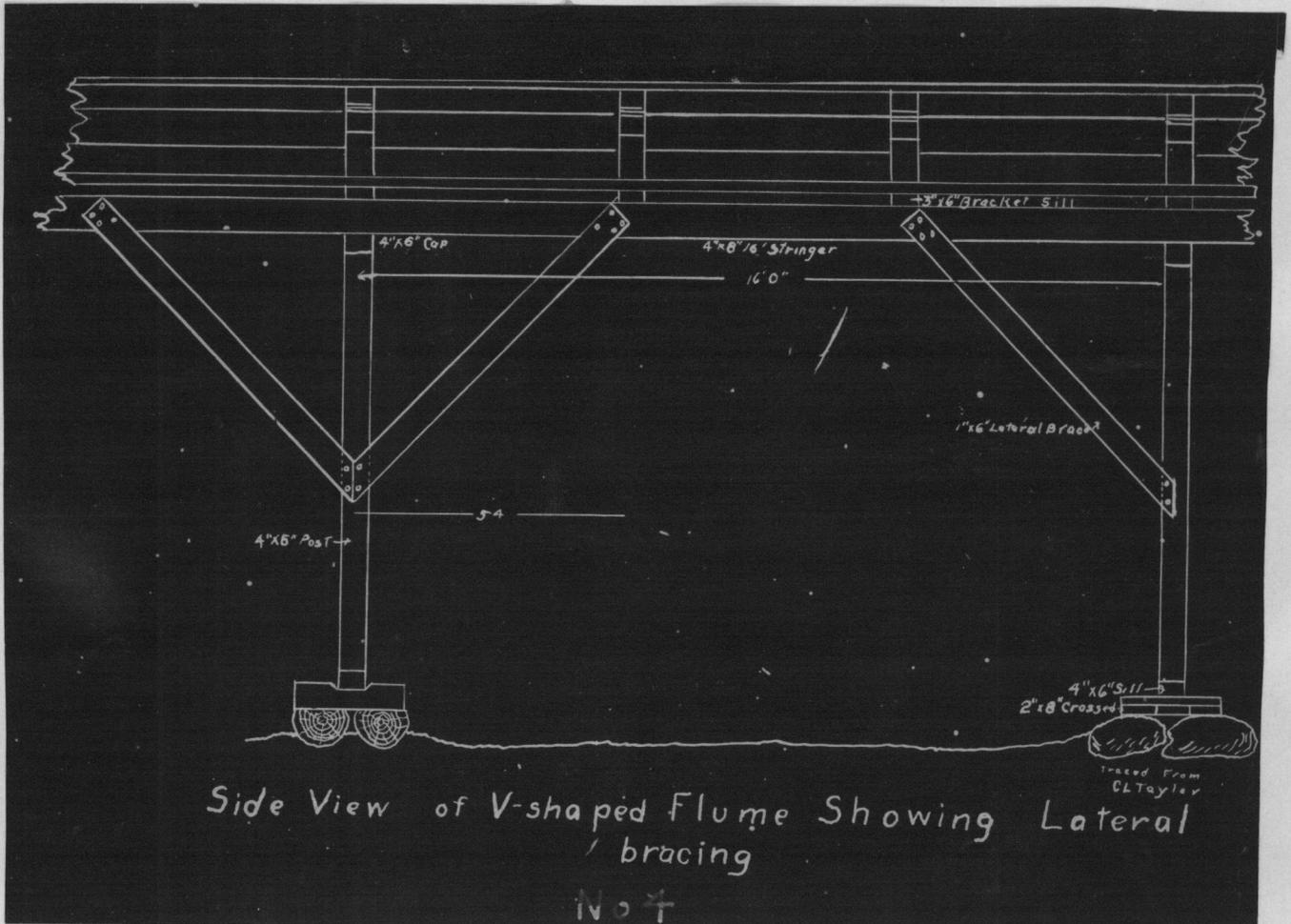
Cut No. 3



canyons, thus avoiding sharp curves and cutting down the length of the flume. Often these trestles can be made from round material on the ground, thereby cutting down cost of transporting material over a long distance.

Although trestling is cheaper than intensive grading, it is advisable, at points of loading, to have the top of the flume even or a little below the top of the ground. This will make it much easier and to load the flume, and if it is set solidly on the ground, where will be less danger of breaking than if up on a trestle.

Cut No. 4.



End and lateral views of flume trestles are shown in cuts 3 and 4. These cuts show the relatively cheap construction used when compared with grading to form a flat even surface for the box.

Tunnels are advisable where one would be required to build the flume around a sharp point, necessitating the putting in of a short curve. Flumes when buildt through tunnels, are advantageously located during the snow season as they will not fill as they would in the open. When the flume is not in use, it will dry out and become leaky when it is in the sun. This trouble is not encountered when the flume is covered by a tunnel.

Construction.

There are several methods of construction used in building flumes. One of the cheapest, and usually the most satisfactory, is to install a small portable sawmill at the head of the flume line and cut the lumber as it is needed. It can be floated to the place where needed, thereby doing away with the cost of hauling or packing the material to the point where it is to be used.

As a flume can be used to transport material in only one direction, it becomes necessary to build some kind of road for the transportation of supplies to the head of the flume if this is the center of the operation or the woods camp. It is advisable to build this road before the construction of the flume is started, thus lowering the cost of transporting material and supplies to the point at which they are to be used.

A telephone line should also be built along the flume so that the watchman will be able to hook on and report any trouble along the line during operation. The line will, also come in handy at the time of construction by making it possible to call the mill to order any material needed at the time.

Box Construction.

The species of lumber used in the flume will depend on the species that can be used in the rough. It is not necessary to season the lumber, but if it is allowed to season it will tighten up when wet and form a much more leak-proof flume.

The mill used for cutting the lumber may be operated by a portable steam boiler and engine, a gas or oil engine, electricity if handy, or by water power. The kind of power to use will depend, of course, on the location and available power. After the mill is installed, miter boxes should be made for cutting braces and frames.

The size of a flume box will depend on the type of material it is to transport. When a small flume will handle the material there is no use in building a large one. For hauling railroad ties, cants poles, cordwood or other similar material, a 30-inch box will usually suffice. If large logs are to be transported, it may be necessary to build a box 60 inches deep, but this is very unusual.

There are several types of flume boxes, but this paper will deal only with the V shaped box. The sides of the box should meet at between 70 and 110 degrees, preferably about 90 degrees as at this angle the greatest capacity can be obtained from the smallest amount of water.

Some operations use a box with one thickness of $1\frac{1}{2}$ inch boards with battens on the outside. These battens may be continuous or they may be between the arms only. The advantages and disadvantages of each type will be taken up later. Another type of V box in general use is that with two layers of boards. In this type the boards overlap as is shown in figure 3. The boards used in the lining of this box are $\frac{1}{2}$ inch thick. The advantage claimed for this type is that it is easier to keep from leaking when alternately wet and dry.

When the single box is left unused for a time it becomes dry and the cracks is put into operation again. In the case of the double-lined box, the space between the linings holds moisture for a longer time, thereby partially eliminating the trouble found in the above case.

Advantages and disadvantages of continuous and non-continuous battens.

A cut showing the continuous battens is seen in figure 5. In this type of box, the arms must be of thicker material to make up in for that which is cut out to provide for the batten. The advantage of this type of batten is that it is easier to keep tight than the other type.

Cut No. 5

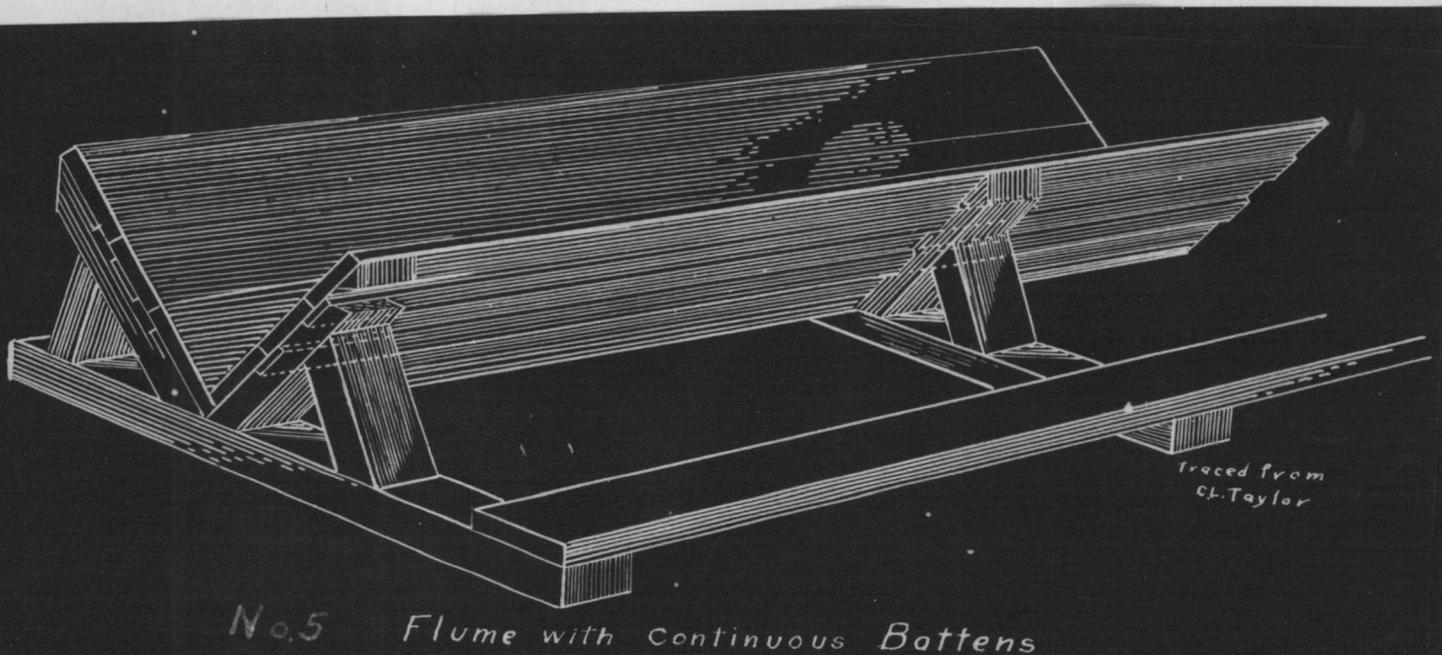
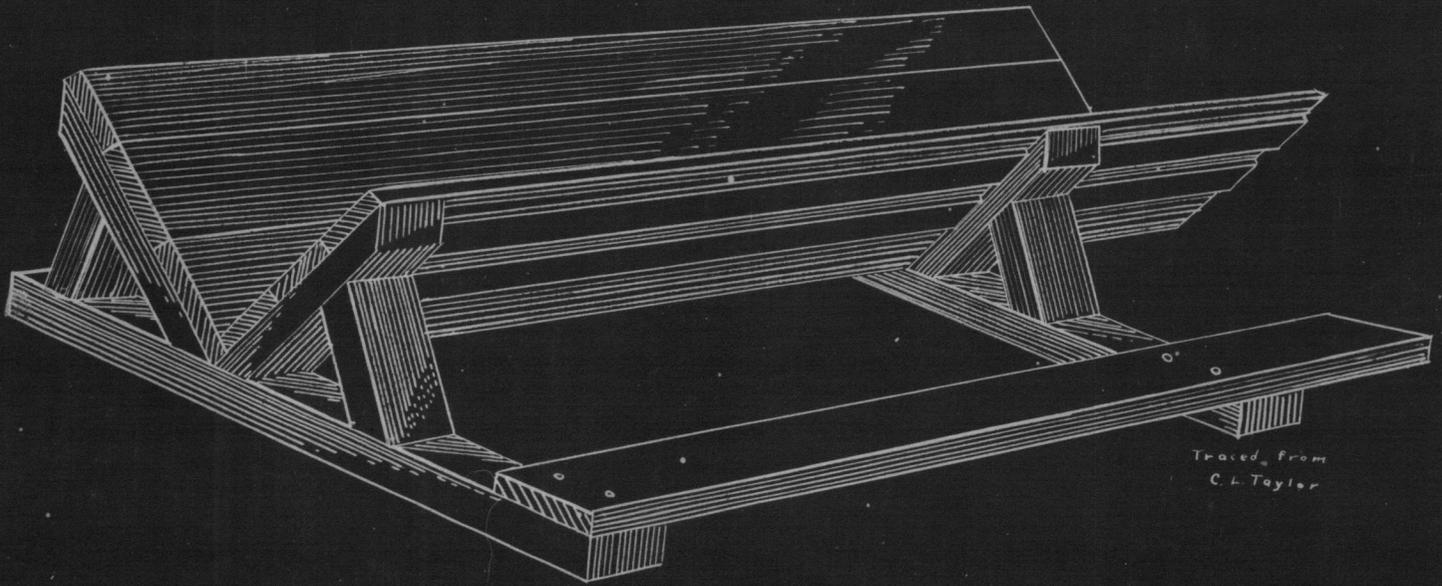


Figure 6 shows the non-continuous batten. It is much easier to change this type in case it becomes split or rotten. Its disadvantage is that it will come loose easier than the continuous batten and, unless it butts tight against the arm, it leaves a hole there, and consequently a leak.

Cut No 6 (shown next page)

Cut No. 6

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*Section of Flume, Batters not Continuous
No. 6*

Nailing.

The problem of keeping the boards in the boxes tight is one not to overlooked, and one which causes much trouble unless met correctly. If the nails are driven from the inside with the heads flush with the board, it will be only a short ime until they become loose and are caught and pulled out by raising material. The best way is to drive the nails from the outside and clinch them with the points toward the direction the water is running. By this method the material passing down the flume will rub on the nails and tend to tighten rather than loosen them as in the case mentioned above.

Feeders.

It is frequently necessary to supply more water, especially in long or leaky flumes. This is done by building a feeder flume from a near-by stream or branch. The feeder flume may be either square or

V-shaped and should be built as cheaply as possible. There is no necessity of paying much attention to grade or construction in this flume, the prime factor being to get water to the main flume. Some times it may be possible to use a branch flume which is to be or has been used for hauling logs from some other show.

Branch Flumes.

Branch flumes are common where there are several streams leading off of the main canyon. These branch flumes should be made as cheaply as possible and in such a way that they can be taken down and moved to another show. In this way the material can be used several times.

Switches and Y's, and Snubs.

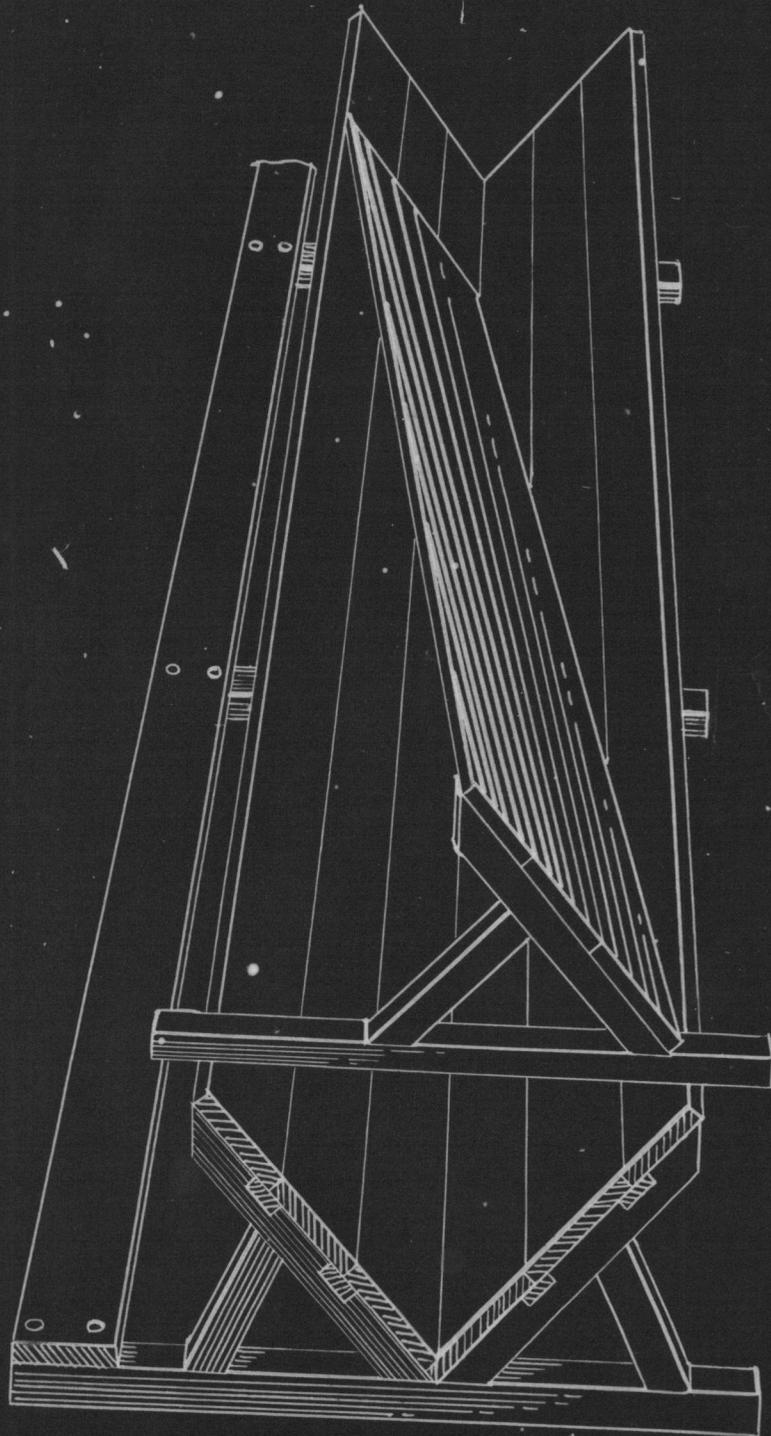
Switches and Y's are sometimes necessary at the lower end of flumes where the material is piled for transfer to railroad cars or for storage. The Y's will make it possible to pile a large quantity of material with very little extra labor.

Snubs are in effect switches for unloading the flume over the side and are very effective when small material is being handled. It is not uncommon when railroad ties or similar material is being shipped to unload them without any outside assistance. A cut of a snub in position is shown in figure 7 on the next page.

Shipping Lumber.

When lumber is shipped, it is sometimes sent loose and sometimes in bundles. The best way to handle boards is to clamp several together and then fasten the bundles together. The bundles of lumber are called, in the industry, "brails", and the tying or fastening together is called "accoutring." The method of clamping and accoutring brails of lumber together for shipment is shown in figure 8. Cut No. 8 is shown on bottom of page 18.

Cut No. 7.



No 7. "Snub" in Position

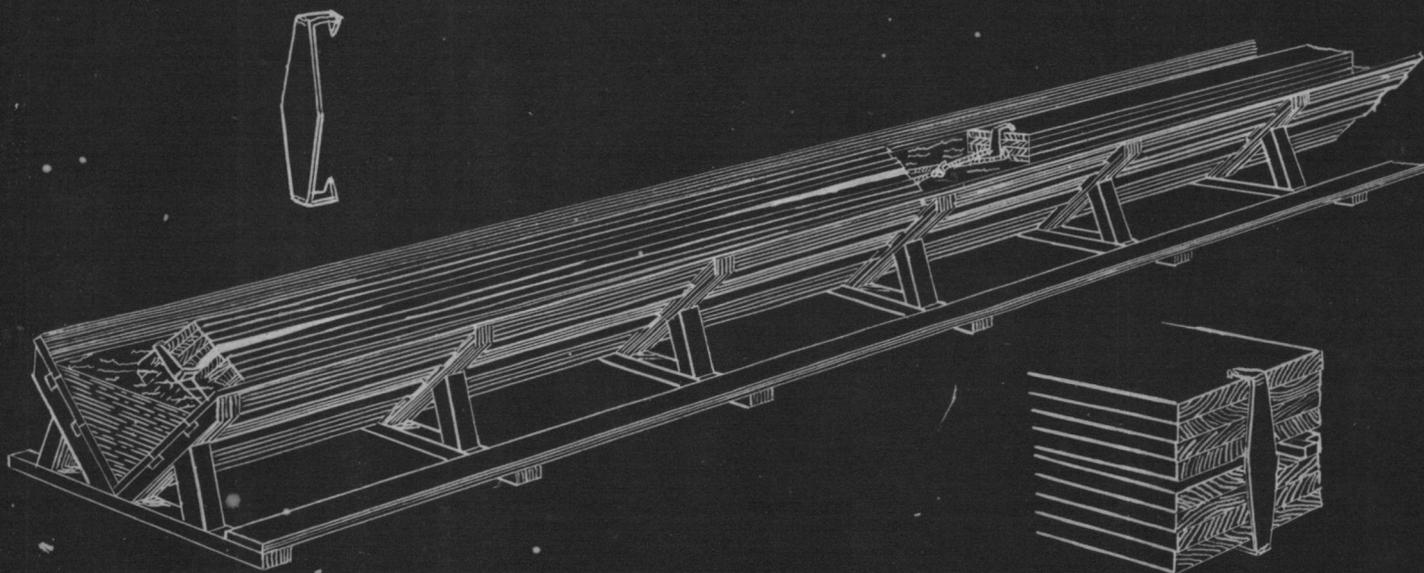
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Operation of Flumes.

There are several methods used in operating flumes, depending on the supply of water on hand. When plenty of water is available for continuous use, the problem of operation is comparatively simple. The water is kept running through the flume at capacity, and whatever is to be shipped is placed in the flume and sent on its way. The method of loading will be discussed later.

If the supply of water is limited to winter and early spring, the problem of operation becomes an important factor. In some cases the logs are piled beside the flume to wait for the winter and spring rains, as

Cut No. 8

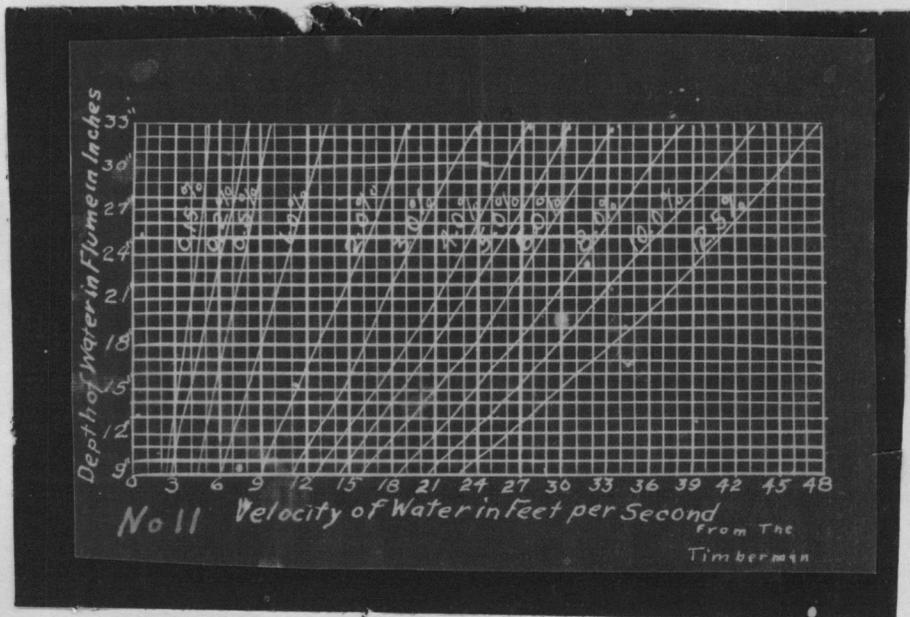
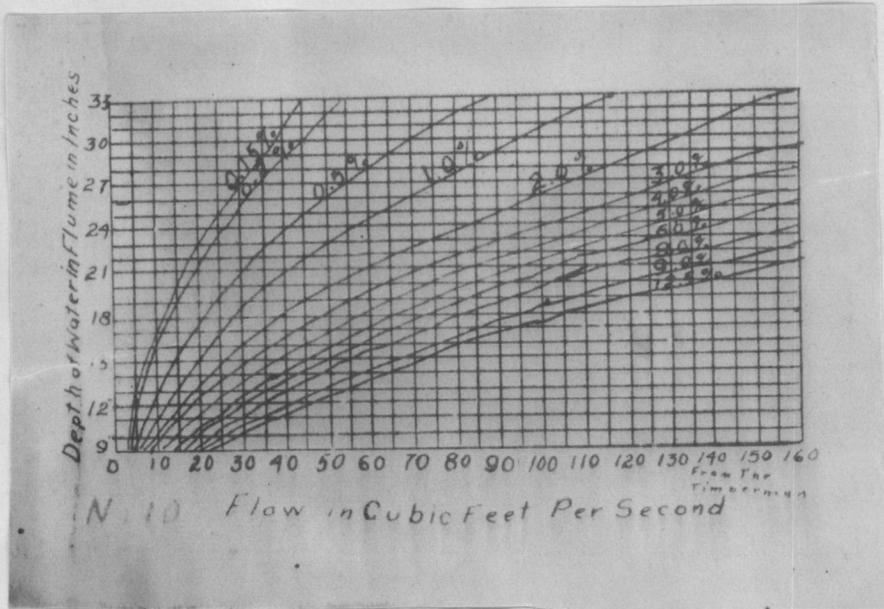
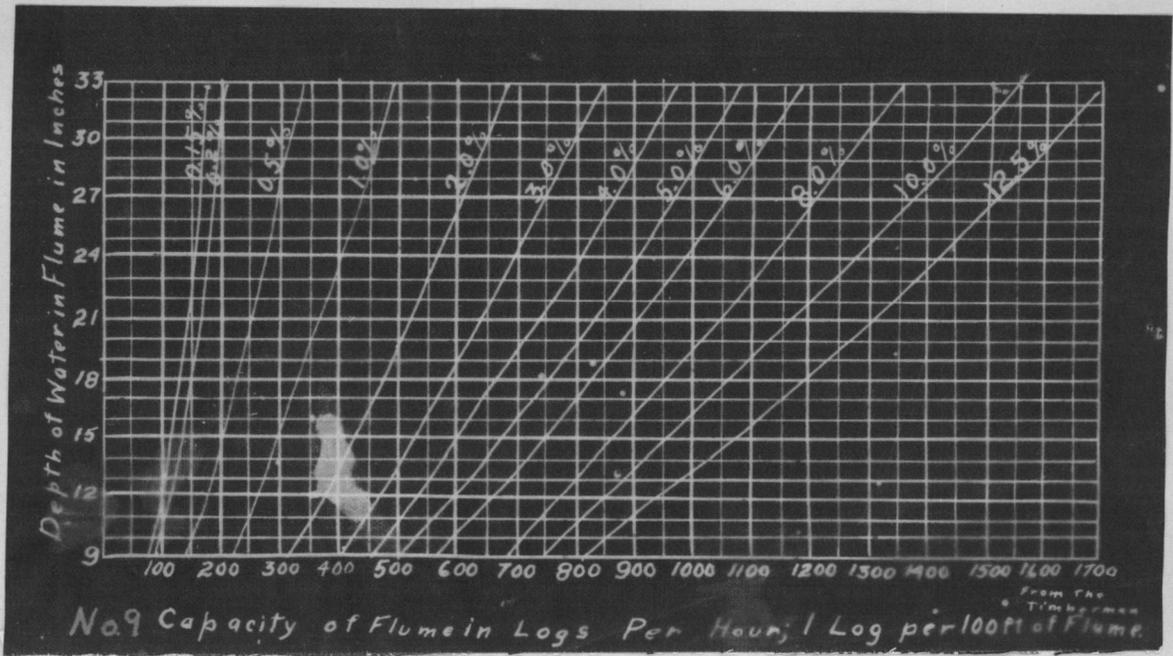


Method of Clamping & Accoutring Brails of
Lumber Together for Shipment

No 8

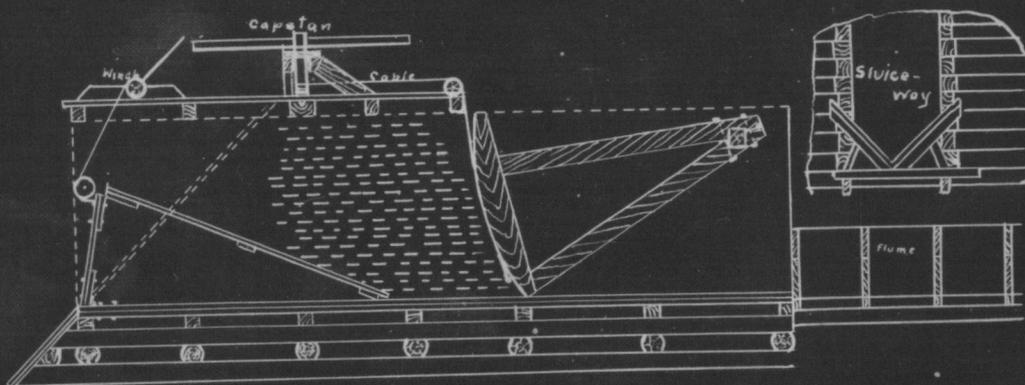
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when the flume will be kept in operation almost continuously, as long as the water lasts or as long as there are logs to ship. Another method is described by Mr. U. B. Hough of Spokane, Washington, who says, "It is often desirable to place timber in a pond formed by and impounding dam. This can be removed to a limited extent when the water has run out so the flume will not overflow at full gate opening, when the timber can be sluiced through. A more convenient way, "states Mr Hough, "and one enabling sluicing of logs during the entire flood is shown in figure 12 in which a bear trap gate is placed in the sluiceway, the shorter log such as to control the flow of water at full head, and the longer log to form a guiding apron for the passage of water to the floor of the sluice below. This trap is hinged to the floor and at the apex with cables attached to the apex hinge pin extended and passing to a winch on the floor of the dam. By lowering this bear trap gate with the winch, a constant flow of water can be maintained and timber sluiced during the entire flood. It is better, however, if it can be done, to place timber in the flume below the dam."

Cut No. 12.



Details of bear trap gate to permit sluicing of Logs during flood
With a constant flow of water

No 12

There are places where it is economically impossible to keep a flume on an even grade. If there are abrupt changes in grade in the flume, or if additional storage space is required for logs, it has been suggested, that storage or relay ponds be installed. These ponds should be at the lower end of the steep grade and at the upper end of a flat grade. Their purpose may be twofold. In the first place, they afford a storage and sorting place for material. If the lower end of the flume is a sorting place for material. If the lower end of the flume is limited in storage space, this relay pond can be used for this purpose, and if different species or grades are being shipped, they can be sorted in the ponds. The other primary use of the pond would be to relieve the flume of the strains transmitted to it by logs or lumber passing over the break in grade, the effects of which were discussed before.

Loading.

One method of loading was discussed in connection with the impounding dam and bear-trap gate. Another method is to bring the logs or lumber to the side of the flume and roll or slide them in as needed. The capacity of a flume under different conditions is shown in figures 9, 10, and 11 on page 21.

Unloading.

For unloading, the method used depends on the size and type of material in question. In the case of small material, the snub as previously described can be used very effectively.

Another method is to have the end of the flume submerged in the water of the log pond and simply float the logs out into the pond. Sometimes the material, such as small logs and cordwood is run out the end of the flume and allowed to drop to the ground. As the pile grows the flume can be lengthened, making a long pile.

Costs.

The costs of flumes vary with the size, cost of material, type of flume built, and tupe of topography in which it is built. The cost vary from \$2,000 to \$10,000 per mile including flume, road and telephone line.

Conclusions.

I would say in conclusion that it would pay almost any operator to investigate flume transportation before planning his operation. This is especially true in regions where the costs of railroad construction is unusually high, or where the stand of timber is relatively small.

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