NONPAREIL CORKBOARD INSULATION

For COLD STORAGE WAREHOUSES ICE PLANTS BREWERIES PACKING PLANTS FUR STORAGE VAULTS DAIRIES CREAMERIES ICE CREAM PLANTS REFRIGERATORS FREEZING TANKS AND GENERALLY WHEREVER REFRIGERATION IS EMPLOYED OR A HEAT INSULATING MATERIAL OF GREAT EFFICIENCY FOR TEMPERATURES UNDER 212° FAHRENHEIT IS REQUIRED

1915 Edition

NONPAREIL
REG. U. S. PAT. OFF.

ARMSTRONG CORK & INSULATION CO.
PITTSBURGH, PA., U. S. A.

BRANCHES OR DIRECT REPRESENTATIVES IN THE PRINCIPAL CITIES OF THE UNITED STATES AND CANADA

The cork oak—native of the Spanish Peninsula and Northern Africa, from the outer bark of which Nonpareil Corkboard is made

Nonpareil Corkboard Insulation

The Vital Importance of Insulation

FOR a good many centuries men have known better than to store wine in leaky vessels. Today no one allows steam that ought to be driving machinery to escape from broken pipes. Nor is electric power permitted to go to waste by failure to insulate properly the supports on which the wires are carried. Yet many men pump refrigeration into rooms day after day, making little or no intelligent effort to prevent the heat from constantly leaking back.

Its Importance is Frequently Overlooked

The reason for this neglect may be sought in several quarters. Heat is a very commonplace thing. We experience its effects every hour that passes. There does not seem to be anything particularly wonderful about it. But if we stop to consider, we find ourselves face to face with the fact that of all known forms of energy, it is one of the most powerful and all-pervading. We can shut out the light; certain substances are impervious even to X-rays; but as for heat, nothing will completely stop its passage.

No one needs to be told the part the refrigerating machine plays in keeping a room cooled to proper temperature. One can see the wheels go round and watch the strokes of the compressor. But as for the insulating material, what good does it do? So the average man is apt to reason. Get anything that will fill up space fairly well, stuff the walls, floors and ceilings, and let it go at that. Insulation does not show; it will all be covered up anyway. Why bother much about it, or spend time and money in designing and installing it?

Right at this point, by following this natural but erroneous reasoning, many plant owners make their first big mistake, the results of which follow hard on their trail for many a year, revealing themselves in the form of increased operating expense, rapid depreciation of machinery and insulation repairs. The fact is that the insulation of any cold storage room is just as important as the refrigerating machinery. Three-fourths of the work of the machine in the average plant is done to remove the heat that leaks in through the walls, floors and ceilings; but one-fourth goes to cool the goods in storage. If you use ice, seventy-five out of every one hundred pounds put into your coolers is melted by the heat that works its way in from all sides. This loss cannot be prevented entirely, because no material is heat-proof. It is possible, though, to cut it down to a point, neither above which nor below which you can profitably afford to go. If any plant is to operate on a truly economical basis, it must be protected against the heat to the point where the cost of any additional insulation would not be offset by the extra saving in operating expense.

Good Insulation is True Economy

As a well-known refrigerating engineer has tersely said: "Insulation should be considered in the light of a permanent investment, just as buildings and equipment, the returns of which should be based on the savings effected by the lower operating cost. It is a great deal cheaper to prevent heat from entering a building than to remove it by means of refrigeration."

Insulation a Permanent Investment

The word *insulation* is derived from a Latin word meaning *island.* The significance, therefore, of the definition of *insulate*, as given in the dictionary, will be readily grasped: "To place in a detached situation, having no communication with surrounding objects." In insulating a cold storage room, what the engineer tries to do, is to make it an island in the ocean of heat.

The Transmission of Heat

Radiation

Heat, though, has several ways of getting about. It can pass through space on the ether waves without appreciably heating the air. Stand in front of a stove, and the truth of this assertion is self-evident. Or perhaps the sensation of warmth that one feels in bright sunlight on a cool day is a better illustration of the *radiation* of heat, as this method of transference is called.

Conduction

When the problem of insulating a cold storage room is under consideration, however, the other two ways that heat moves are of more importance. By *conduction* is meant the transference of heat from one molecule or particle of matter to another by impact. For instance, put one end of a poker in the fire, and soon the other end will get hot, although far removed from the source of heat. This is exactly the process that goes on in the walls of a cold storage room. The outside is heated by the sun's rays or the warm air. The molecules on the surface are first set in motion. Gradually the movement spreads and goes deeper and deeper into the wall. When the molecular excitement gets into the insulation, it travels forward less rapidly. The progress of the heat is impeded, just as piling along the water front breaks the force of the incoming waves. Still, some of the heat eventually passes through, the amount depending upon the efficiency of the insulation.

Slowly but surely the temperature of the room rises, unless refrigeration is continuously applied to offset the heat leakage.

The heat conductivity of dense substances—metals, whose molecules are heavy and close together

Convection

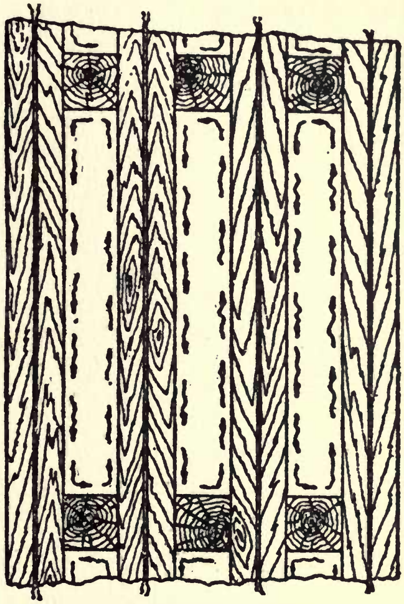
—is very high; the conductivity of lighter materials, such as wood, is less; while that of gases is extremely low. Hence, air, the most available gas, is the most efficient insulator that can be had, if a vacuum, which is impracticable on a large scale, be excepted. But the problem is to confine the air so that it cannot circulate; for the transmission of heat is also effected by a third method called *convection*, or in other words, the carrying of heat from one point or object to another by means of some outside agent, such as air or water, or any moving gas or fluid. The principle of convection is well illustrated in an ordinary house furnace. The rooms of the house are, in such cases, warmed by means of a current of heated air. In the hot water heating system, water is the medium utilized to carry the heat from the boiler to the room to be heated. No mechanical means has to be employed in either case, to make the air or water circulate. Ducts or pipes are provided, and the hot air or water rises as it is warmed and drops as it becomes cool, thus automatically setting up circulation.

On a miniature scale, a similar process takes place in every form of insulation. To make this point clear, there is shown on the next page a cross-section

Passage of Heat Through Insulation

of boards-and-air-space insulation, consisting of air-spaces from one to two inches thick and twelve inches high, formed by alternating layers of boards and furring strips. The side of the insulation next to the outer air is, of course, warmer than the side next to the cold room. The air against the outer wall of each air-space in the insulation becomes heated and rises, its place being taken by the cold air from the other side. As this becomes warm, it forces its way upward; the other part, having gradually cooled, drops to the bottom; and thus a constant circulation is set up inside the air-space itself. This movement tends to equalize the temperature on both sides of the air-space and will continue as long as there is any difference in temperature. From this it is obvious that the fewer the air-spaces, the more rapidly will heat pass from one side of insulation to the other. Therefore, the best insulation is that which embodies the greatest number of the smallest possible air-spaces, for the smaller the air-spaces the less extensive will be the effect of the circulation of the air confined therein. The problem is, then, so far as the nonconduction of heat is concerned, to find some material which contains a large amount of entrapped air absolutely confined in minute particles.

Inside Cold



Outside Warm

Convection in boards-and-air-space insulation

Smallest Possible Air-Spaces

Requirements of Good Cold Storage Insulation

To meet the demands of modern cold storage construction, however, a suitable insulating material has to possess a number of other qualifications besides being an excellent nonconductor of heat. The plant owner demands that the insulation he installs shall retain its efficiency indefinitely. This is merely another way of saying that it must not absorb moisture, for water is a good conductor of heat, and any insulating material that will absorb it, will in a short time become worthless.

A Good Nonconductor

Nonabsorbent

Sanitation requires that all insulating material shall keep free from rot, mold and offensive odors, and be vermin- and germ-proof. The delicacy of certain food stuffs, such as milk, cream, butter and eggs, requires that the insulation shall be odorless, as otherwise there is danger of taint.

Sanitary and Odorless

Economical building calls for the use of insulation that will occupy the least possible room and leave the maximum amount of storage space. Expediency demands that the material be easily erected and have ample structural strength. The fire underwriters insist on the fire risk being reduced, as far as possible, by the installation of some material which will not only be slow-burning, but which will leave no flues in the walls to assist in the spreading of fire once under way. Finally, the material must be reasonable in cost.

Strong, Compact and Fire-Retarding

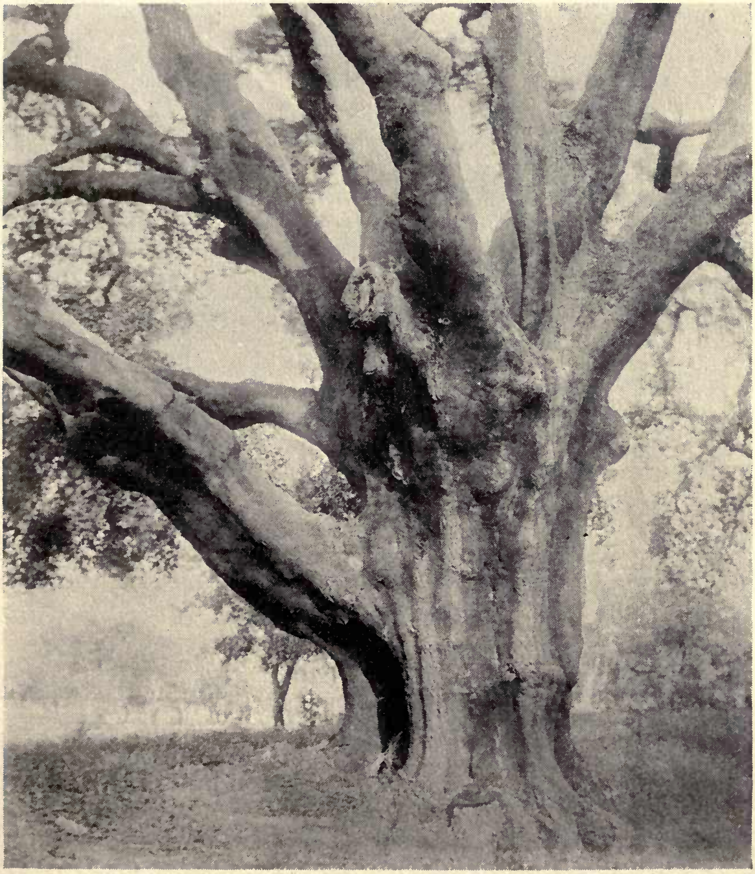
Summarizing, it will be seen that a good cold storage insulating material must be:

Summary

1. A good nonconductor of heat;
2. Nonabsorbent of moisture and, therefore, durable in service;

3. Sanitary and odorless;
4. Compact—occupying but little space;
5. Structurally strong and, therefore, easy to install;
6. Slow-burning and fire-retarding;
7. Reasonable in cost.

Nonpareil Corkboard meets these requirements to a greater degree than any cold storage insulation that has yet been devised, for in cork, Nature herself has supplied a material particularly well-suited for this purpose. **Cork—A Natural Insulator**



Gnarled trunk of an old cork tree, showing heavy outer bark—the cork of commerce

Nonpareil Corkboard

The Pioneer Form of Solid Insulation

Many years ago the merits of granulated cork as an insulating material were generally recognized, but it was not until about twenty years since that widening knowledge of the technique of refrigeration created a demand for cork insulation in sheet or board form. To satisfy this demand, Nonpareil Corkboard, the pioneer type of solid insulation, was put on the market; and it has remained the standard through all the years that have elapsed.

Nonpareil Corkboard

What Nonpareil Corkboard Is

Nonpareil Corkboard consists of pure granulated cork compressed in metal molds and baked at a moderate temperature. The baking process brings out the natural gum or rosin in the cork, binding the whole mass together firmly. No foreign binder is used, for under the peculiar process of its manufacture none is necessary. It is cork, pure cork, and nothing but cork; and in this stands in marked distinction from many of the other forms of corkboard which have been put on the market in recent years. Some such contain a foreign binder—glue, asphalt, pitch or cement—and aside from other points of inferiority are, of necessity, from the presence of such substances, less efficient as nonconductors of heat. In Nonpareil Corkboard, only cork—the real insulating agent—enters.

Nonpareil Corkboard is manufactured in sheets of standard size, 12 x 36 inches, in the following thicknesses: $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{2}$, 2, 3, 4 and 6 inches. For details regarding weights, freight Sizes

Cork strippers at work in Portugal

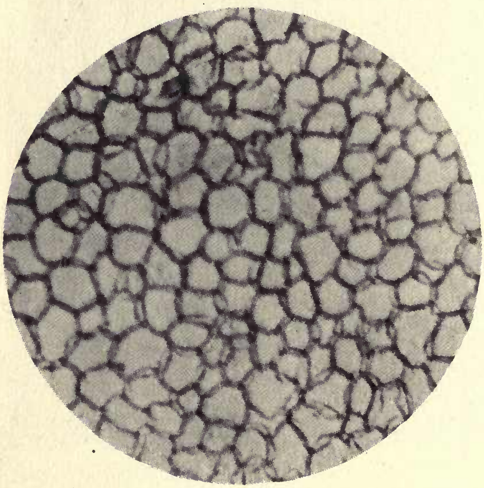
classifications, shipping crates, etc., refer to pages 132 and 133. Let us now see how the material measures up with the requirements for a good cold storage insulating material as above set forth:

I. Nonpareil Corkboard is an Excellent Nonconductor of Heat.

In order to understand why Nonpareil Corkboard is such an efficient nonconductor of heat, it is necessary to explain what cork is and where it comes from. This peculiar substance is the outer bark of the cork oak, a tree that flourishes in the hot and semi-arid climate of the Spanish Peninsula and Northern Africa. Sheathing trunk and branches, it prevents the sun's rays and parching winds from drying up the cool, life-giving sap that mounts upward through the inner bark—the real skin. When fire sweeps through the forests, the cork tree alone survives, thanks to its protecting shield of bark.

The Cork Tree

It is not surprising, therefore, to find that natural cork is an excellent nonconductor of heat.



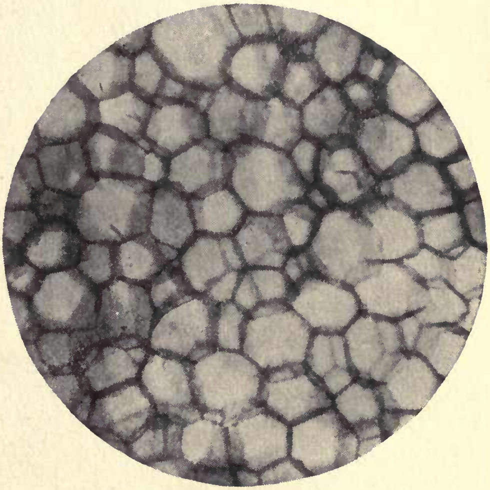
Cork under the microscope

The reason becomes plain when the bark is examined under the microscope. Its peculiar structure can then be clearly seen—myriads of minute air-cells separated from each other by thin walls of tissue. Each of these microscopic cells contains a bit of entrapped air, and each one, moreover, is sealed up tightly by Nature herself, and thus rendered impervious to air and moisture. In other words, cork fulfills the essential requirements of a good nonconductor of heat since it "contains a large amount of entrapped air, absolutely confined in minute particles." (See page 11.)

Cork Composed of Minute Air-Cells

The cellular structure of the natural cork is not destroyed or even injured by the process of manufacture. This is proved by microscopic inspection of the finished product. The pressure to which the granulated cork is subjected goes principally to fill up the voids between the granules, while the baking process actually increases the insulating value of the raw material in two ways: First, by driving off the sap, thus increasing the volume of confined air; second, by coating the surface of each separate granule with a thin film of the natural waterproof gum, which affords an additional barrier against the entrance of moisture. Compare the photograph of Nonpareil Corkboard under the microscope on this page with that of natural cork on the page preceding. Both are reproduced on the same scale so that fair comparison can be made.

Manufacturing Process Increases Efficiency



Nonpareil Corkboard under the microscope, showing concealed air cells

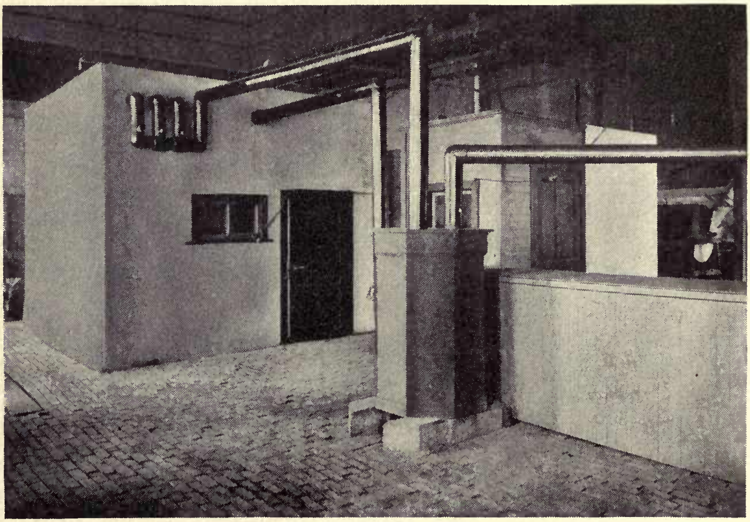
It is, therefore, the peculiar cellular structure of cork combined with the manufacturing process that gives Nonpareil Corkboard its remarkable insulating efficiency. Exactly how efficient it is, in comparison with other materials, is shown by the tests described on the following pages.

Its Insulating Value

The Determination of the Heat Conductivity of Nonpareil Corkboard and other Insulating Materials

A Complicated Proceeding

To determine accurately the heat conductivity of any material is a complicated as well as an expensive proceeding. Many experiments along this line have been made both by physicists in the interests of science and by engineers on behalf of their clients. The results have varied considerably in the absence of any standard apparatus or plan of procedure. The most common method has been a small box built of, or lined with the material to be tested, cooled by melting ice. This, from its mere crudeness, is apt to be unreliable. In fact, the results thus obtained are often of little value even in determining relative efficiency. The only fair way to test the heat conductivity of cold storage insulation is on a comparatively large scale, under conditions paralleling those encountered in actual practice, viz.,



Testing plant

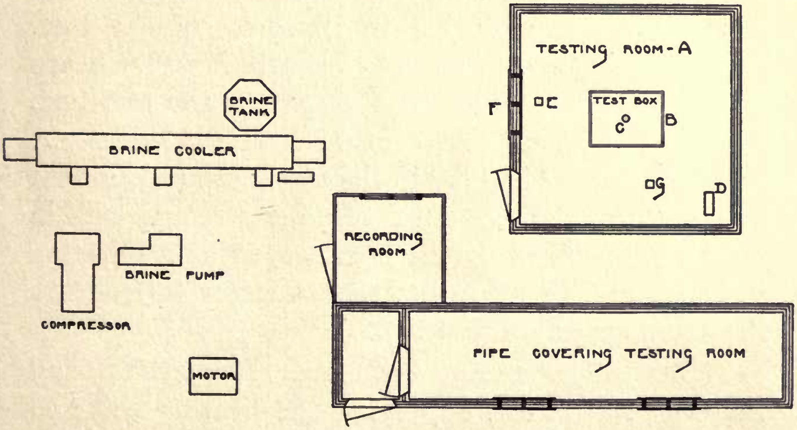
air contact, cold storage temperatures and mechanical refrigeration, combined with positively accurate methods of measuring the heat loss.

With these facts in mind, and determined to get at the truth for their own as well as their customers' protection, the Armstrong Cork & Insulation Company installed at Pittsburgh some years ago a heat transmission testing plant which is unique in scope and equipment. All told, more than $30,000 has been expended in its construction and in the tests already made. The apparatus itself has recently been moved to the Company's factory at Beaver Falls, Pa.

Thermal Insulation Testing Station

The plant (see plan) consists of the testing room (A) twelve feet square by ten feet high, the walls, ceiling and floor of which are insulated with six inches of corkboard, so that any desired temperature as low as 0° F. can be maintained without variation by means of a three-ton refrigerating machine. The brine circulating system is used. A twelve horse-power motor supplies the power.

Description



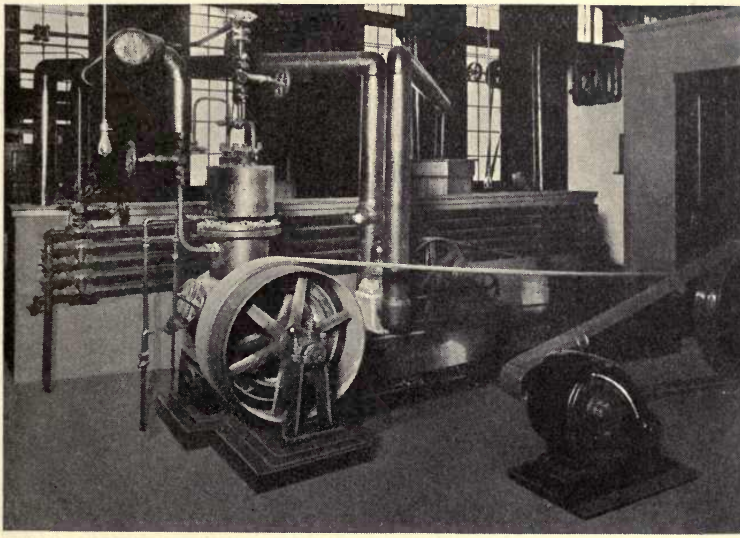
Plan of testing plant
A—Testing room. B—Test box. C—Test box thermometer.
D—Fan in testing room. E—Testing room thermometer.
F—Window. G—Recording thermometer.

The Testing Apparatus

The method employed in making tests is as follows: Inside the testing room (A) there is built a box (B) of the material to be tested, measuring from three to four feet each way and affording, therefore, a radiating surface of from fifty to ninety-six square feet. Little or no lumber is used when the material is self-supporting, for it is desirable, of course, to eliminate foreign material to the greatest possible extent; but when loose materials, such as granulated cork, shavings, cinders, mineral wool, etc., are being tested, a containing box of lumber has to be utilized. Before the test box (B) is sealed up, an electric heating coil and a small electric fan are placed inside, the holes through which the wires pass and all joints of the test box being hermetically closed with a thin coating of hot asphalt. The test box is raised a foot above the floor of the testing room on light supports, thus obtaining air contact on every side. In the top of the test box, a long stem thermometer (C) is sealed, the scale protruding above so that the temperature inside may be observed constantly during the progress of the test. In the testing room, another electric fan (D) keeps up a constant circulation of air about the test box, ensuring uniform temperature on all sides. A thermometer (E) is hung in the testing room opposite the window (F), so that the temperature within can be determined by the operator without entering the room. The recording thermometer (G) checks the readings thus made.

When all is ready, both the refrigeration and the electric current, supplying the heating coil and the fans, are turned on, and at least forty-eight hours allowed to elapse before any observations are taken, in order to obtain constant temperature conditions and to insure the uniform transmission of heat through the test box. The temperature at which the test box is held is usually 90° F.; the temperature of the testing room 10° F.; the difference,

The Procedure

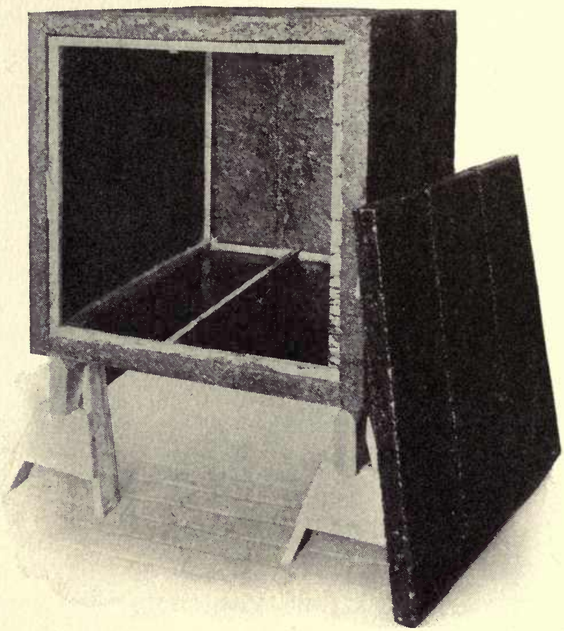


Testing plant—refrigerating machinery

therefore, being 80° F. This is purely an arbitrary matter, and in making check tests the temperature is usually varied; for instance, by holding the test box at 80° and the testing room at 10°; or, the test box at 85° and the testing room at 15°.

Observations

After conditions have become constant, observations are made every ten or fifteen minutes, as may be determined upon, for a period of from three to five hours. The amperage and voltage of the currents supplying, respectively, the heating coil and the small fan sealed up in the test box, the temperature of the testing room, and the temperature of the test box, all are carefully read and recorded. During the duration of the test, these temperatures are kept practically constant, either by controlling the ammonia expansion valve and the brine circulation, or by increasing or decreasing, as may be required, the current supplied to the heating coil in the test box.



Test box built of two-inch Nonpareil Corkboard

Computing the Results

The heat transmission is computed in the following manner: The average difference in temperature between the test box and the testing room, the average voltage, and the average amperage of the currents supplying the small fan and heating coil, respectively, are first determined. The test box is carefully measured and the mean area computed. With these data, by means of the following formula, the heat transmission per square foot, per degree difference in temperature, for twenty-four hours, in British Thermal Units, is readily computed:

Let F. A. = Average Amperage of Fan Circuit.
Let F. V. = Average Voltage of Fan Circuit.
Let C. A. = Average Amperage of Heating Coil Circuit.
Let C. V. = Average Voltage of Heating Coil Circuit.
1 Ampere x 1 Volt = 1 Watt.
Therefore, (F. A. x F. V.) + (C. A. x C. V.)
= Average Watts Supplied Test Box.
1 Watt = .05686 B. T. U. per minute.
Let D = Average Difference in Temperature of Test Box and Testing Room in Degrees F.
Let A = Mean Area of Test Box in Square Feet.
1440 Minutes = 24 hours.

Then $\dfrac{[(F.A. \times F.V.) + (C.A. \times C.V.)] \times 1440 \times .05686}{D \times A}$
= B. T. U. per square foot per degree difference in temperature in twenty-four hours.

A British Thermal Unit, or "B. T. U."—the unit of measurement—is the amount of heat required to raise a pound of water at maximum density one degree Fahrenheit.

Standard Basis of Comparison

Since the transmission through any insulating material of uniform structure is in inverse proportion to its thickness (within the ordinary range of cold storage temperatures), the results thus obtained may be readily reduced to the standard one-inch thickness basis by simply multiplying the transmission per square foot by the thickness of the tested specimen in inches. All results are checked by means of several runs, and, in addition, usually by two or more observers working independently in ignorance of each other's results. The instruments with which the electric currents are measured are of the most delicate type, and with their assistance the amount of heat driven into the test box may be determined with accuracy.

The complete log of a test on two-inch Nonpareil Corkboard, made November 6th, 1907, is shown below:

Log of Test on Two-inch Nonpareil Corkboard

November 6th, 1907

Time	T. 1 Degrees F.	T. 2 Degrees F.	D Degrees F.	FAN		COIL	
				Volts	Amp.	Volts	Amp.
10:50	90.0	9.8	80.2	103.8	.50	45.4	2.37
11:00	90.0	9.7	80.3	104.5	.49	43.8	2.31
11:10	90.0	9.7	80.3	104.3	.50	41.9	2.42
11:20	90.0	9.8	80.2	105.0	.50	42.7	2.31
11:30	90.0	9.7	80.3	105.0	.50	44.0	2.27
11:40	90.0	9.7	80.3	105.0	.50	43.7	2.30
11:50	90.0	9.7	80.3	104.4	.49	43.5	2.29
12:00	90.0	9.5	80.5	105.0	.50	44.0	2.32
12:10	90.0	9.6	80.4	107.0	.50	43.1	2.28
12:20	90.0	9.7	80.3	107.5	.50	43.2	2.29
12:30	89.9	9.8	80.1	106.7	.50	43.5	2.30
12:40	89.9	9.8	80.1	106.5	.50	43.8	2.30
12:50	89.9	9.6	80.3	107.1	.49	43.7	2.31
1:00	89.9	9.5	80.4	106.0	.49	43.6	2.30
1:10	89.9	9.6	80.3	106.5	.49	43.5	2.29
1:20	90.0	9.6	80.4	106.5	.50	45.5	2.38
1:30	90.0	9.5	80.5	105.3	.50	45.6	2.38
1:40	90.1	9.5	80.6	105.5	.50	45.5	2.38
1:50	90.1	9.4	80.7	106.0	.50	44.3	2.32
2:00	90.2	9.6	80.6	105.5	.50	43.0	2.27
2:10	90.1	9.7	80.4	105.8	.50	43.3	2.27
2:20	90.0	9.7	80.3	105.0	.50	43.2	2.25
2:30	90.0	9.6	80.4	105.5	.50	44.0	2.32
2:40	90.0	9.5	80.5	105.8	.50	43.8	2.33
2:50	90.0	9.5	80.5	106.0	.50	44.5	2.33
3:00	90.0	9.6	80.4	105.5	.50	44.0	2.33
Average of 26 readings			80.37	105.64	.498	43.85	2.316

A correction of .08 must be subtracted from fan ammeter readings.

Mean area of box—48.72 square feet.

$$\frac{[(105.64 \times .418) + (43.85 \times 2.316)] \times 1440 \times 0.05686}{80.37 \times 48.72} = 3.0 \text{ B.T.U.}$$

2″ Nonpareil = 3.0 } B.T.U. per square foot per 1° difference
Therefore 1″ Nonpareil = 6.0 } of temperature for twenty-four hours.

The average of twelve tests conducted by the Company's own engineers at this plant previous to April 1909 gave the heat conductivity of Nonpareil Corkboard as 6.2 B. T. U. per square foot per degree difference in temperature per twenty-four hours as shown in the following table:

Twelve Tests on Nonpareil Corkboard

Material	Thickness	Transmission in B.T.U. per Sq.Ft.per Deg. F.Diff.in Tem. for 24 Hours	Transmission in B.T.U. per Sq.Ft.per Deg. F.Diff.in Tem. per 1 in.Thick. per 24 Hours	Date
Nonpareil Corkboard	1-inch	6.4	6.4	Sept. 6, 1907
" "	1 "	6.4	6.4	Oct. 2, 1907
" "	1 "	6.2	6.2	Oct. 3, 1907
" "	1 "	6.2	6.2	Oct. 4, 1907
" "	2 "	3.0	6.0	Nov. 6, 1907
" "	2 "	3.0	6.0	Nov. 7, 1907
" "	2 "	2.9	5.8	Nov. 8, 1907
" "	2 "	3.0	6.0	Nov. 13, 1907
" "	2 "	2.9	5.8	Nov. 14, 1907
" "	2 "	3.0	6.0	Nov. 15, 1907
" "	3 "	2.2	6.6	June 7, 1907
" "	3 "	2.2	6.6	June 22, 1907
Average of 12 Tests			6.166	

During the spring of 1909 Mr. Walter Kennedy, the well-known mechanical engineer of Pittsburgh, made a series of experiments on his own behalf at the Company's testing plant, the results indicating that the heat conductivity of Nonpareil Corkboard was 6.5 B. T. U. per inch thickness per square foot per degree difference in temperature per twenty-four hours. (See tables on pages 41 and 42.)

Tests By Walter Kennedy, M.E.

While having the utmost confidence in these results, the Company then decided to go one step further and accordingly requested Charles L. Norton, Associate Professor of Heat Measurements, Massachusetts Institute of Technology, Boston, Mass.—

Tests by Professor C. L. Norton

an eminent authority on this subject—to make exhaustive tests, not only on Nonpareil Corkboard but on a number of other insulating materials. His experiments were begun in the summer of 1909 and continued over a period of five or six months, all of them being conducted in the laboratories of the Massachusetts Institute of Technology. Five different methods of testing were employed, known as, the ice-box method, the oil-box method, the hot-air box method, the cold-air box method and the flat-plate method. The so-called "hot-air box method" is similar to that used in the Company's testing plant at Beaver Falls, Pa., described above.

Professor Norton's Results

The materials tested by Professor Norton were secured by purchase in the open market and also direct from the manufacturers. The results he obtained may, therefore, be regarded as conclusive.

	Transmission through Nonpareil Corkboard per one-inch thickness, per square foot, per degree difference in temp. per 24 hours
Ice-Box Method	6.1 B. T. U.
Oil-Box Method	6.4 B. T. U.
Hot-Air Box Method	6.9 B. T. U.
Cold-Air Box Method	6.0 B. T. U.
Flat-Plate Method	6.7 B. T. U.
Average	6.4 B. T. U.

Professor Norton's reports are given in full on the following pages:

Reports on Tests of Nonpareil Corkboard and Waterproof Lith

By PROFESSOR CHARLES L. NORTON

Boston, February 7, 1910

I hand you herewith copy of report which you requested on the materials used for cold storage insulation and sold under the name of Nonpareil Cork and Waterproof Lith.

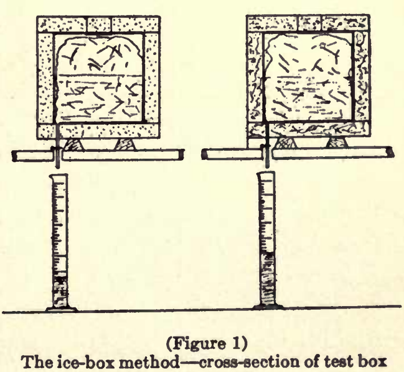
The Nonpareil Cork is a material composed wholly of cork chips and fragments, compressed with sufficient heat to enable the natural resins to stick the fragments firmly together with no other cementing material.

The Waterproof Lith consists of a felted mass of fibres composed in part of what appears to be mineral wool, the balance being a vegetable fibre; the whole fabric is then waterproofed by means of some oily substance.

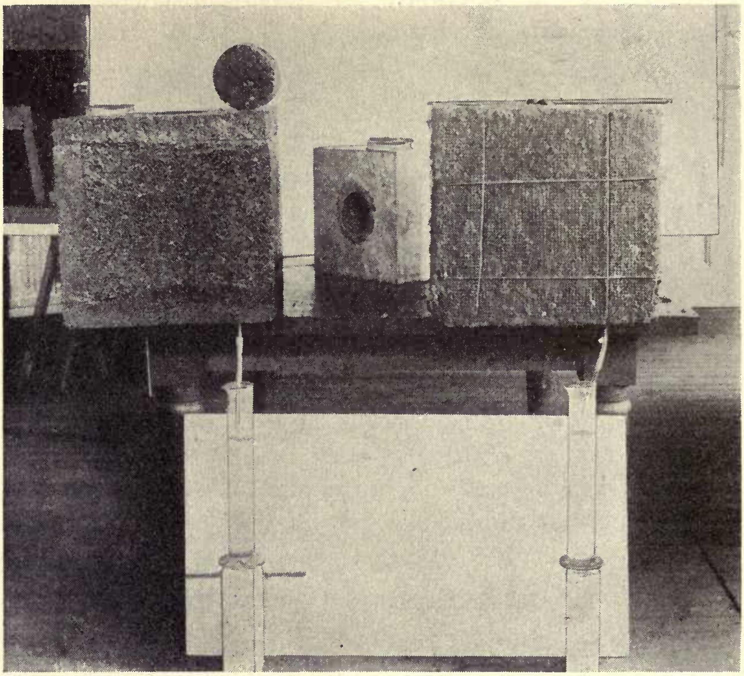
Tests of Thermal Conductivity

The relative thermal conductivity of the Nonpareil Cork and Lith has been determined by a number of methods. The first and simplest of these methods, which is sometimes referred to as the "ice-box" method, consists in covering the outside of two identical boxes of metal with the substances under investigation; then filling the two boxes with ice and noting the rate at which the ice melts. Because of the uncertainty of keeping the entire box at exactly 32° F., even though it be partially filled with ice, this method may lead to inaccurate results. However, if proper care is taken to keep the boxes full of ice and to retain the water formed by the melting of the ice and to make a suitable correction for the somewhat higher temperature of the top of the box with which the ice makes

The Ice-Box Method



(Figure 1)
The ice-box method—cross-section of test box



(Figure 5)
The test boxes—ice-box method

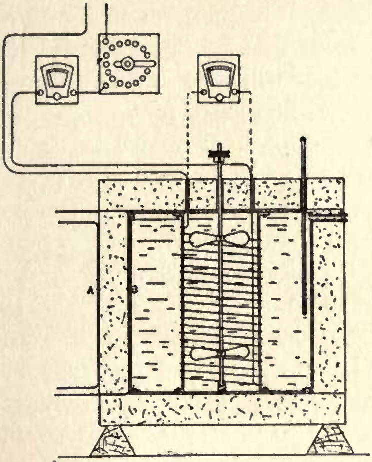
The Ice-Box Method

very poor contact, fairly accurate results may be secured. The method is liable to minimize the differences between two materials and to give values which are too low. By this method, however, the best values which could be obtained after repeated trials were as follows:

Nonpareil Cork........................6.1 B. T. U.
Waterproof Lith........................7.9 B. T. U.

These figures are given in British Thermal Units transmitted through one square foot of material, one inch thick, in twenty-four hours, when there is one degree difference between the two surfaces. The British Thermal Unit is the amount of heat necessary to raise one pound of water through one degree Fahrenheit.

The second method adopted may be described as the "oil-box" method. This is an adaptation of the method used by the writer for a long time in testing steampipe covers. A

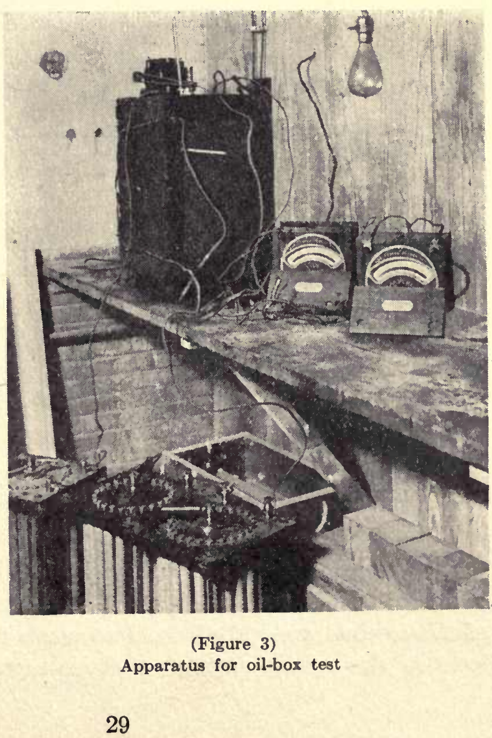


(Figure 2)
The oil-box method—cross section of test box

box of metal approximately cubical in form is covered on all sides with the insulating material to be tested. It is filled with mineral oil and contains an electric heater and stirrer. By means of the electric heater any desired difference in temperature can be maintained between the box and the room. The exact amount of heat lost by conduction through the covering of material under test can be determined from electrical input. This is measured by an ammeter and voltmeter.

The Oil-Box Method

The relation between electrical and heat units may be summarized as follows: When one ampere passes through the heater under pressure of one volt, electrical energy is supplied at the rate of one volt-coulomb per second, or at the rate of one watt. One volt-coulomb has been very carefully determined to be equal to .0009472 B. T. U. So that from our electrical measurements we may deduce the number of B.T.U.



(Figure 3)
Apparatus for oil-box test

merely by multiplying the volts by the amperes and multiplying their product by .0009472. If this figure be divided by the area of the box in square feet, it will give us the number of B. T. U. transmitted through each square foot of surface per second. Since the transmission of heat varies inversely with the thickness, it is necessary to multiply the figure given above by the thickness in inches, and by further multiplication by the number of seconds in one day (86,400) the results may be reported in British Thermal Units per square foot, per inch thickness, per twenty-four hours. It is customary to report further on the basis of one degree difference between the two surfaces of the material under test, and this may be done by dividing directly by the number of degrees difference in temperature as found during the test. Writing this as an equation, we have

B. T. U. per 24 hours, per 1° F., per sq. ft., per in. thick,

$$= \frac{\text{Amperes x Volts x 86400 x .0009472 x thickness}}{\text{Temp. diff. x area tested}}$$

In general we may write

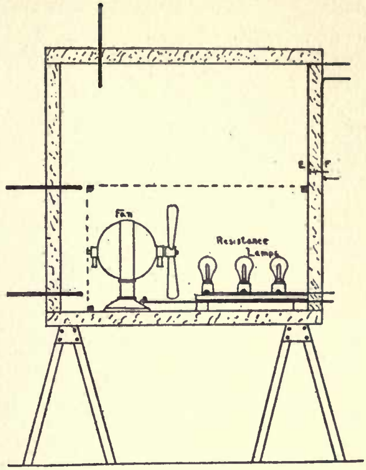
$$K = \frac{Q.\ d.}{A.\ t.\ s.}$$

Where Q is the quantity of heat passing through an area A in time s, when a thickness d has a temperature difference of $t°$ between its two sides.

This method enables us to work only at temperatures above the room in which the test is made, but it has been found that the efficiency of the insulations does not vary much over quite wide ranges in temperatures—at least, over such ranges of temperature as are met with in modern refrigeration. Using this method, the following values were found after a very considerable number of tests:

Nonpareil Cork........................6.4 B. T. U.
Waterproof Lith........................8.4 B. T. U.

The same difficulty which was met with in connection with the ice-box developed here, namely, the uncertainty as to the temperature of the top of the box. However, just as the errors of the ice-box method all tend to make the measurements too low, so the errors in this method, namely the loss of heat through the stirrer rods, loss of heat through the supports, evaporation of the oil and conduction through the overflow pipe, tend to make the results given by this apparatus too high. It is not believed, however, by the writer, that there is any great danger of this apparatus yielding results which are inaccurate so far as the relative efficiency of different materials of the same thickness is concerned.



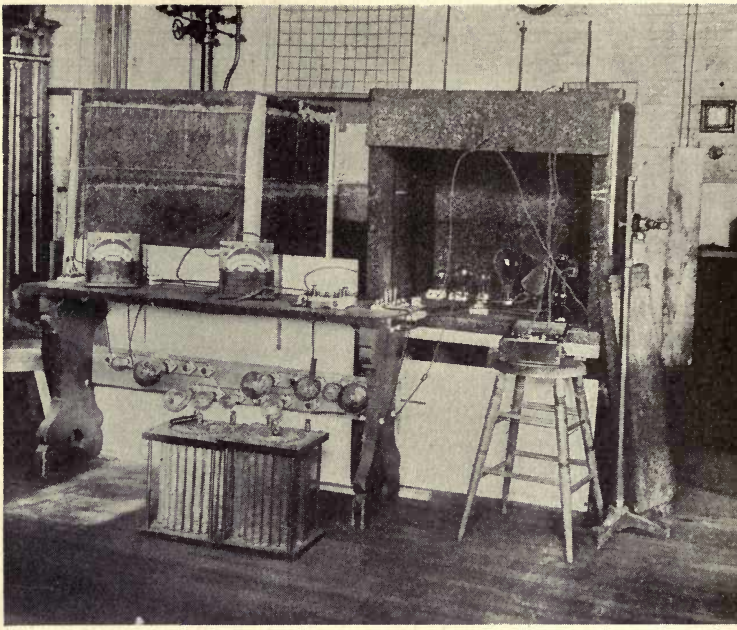
(Figure 4)
The hot-air box method—cross-section of test box

The third method adopted, which may be termed the "hot-air" box, was not unlike the previous method. Just as before the measurement of the heat supplied to a cubical box was made by electrical method. The apparatus consists of a box constructed wholly of the material to be tested with only such light wooden supports as may be necessary for strength.

The Hot-Air Box Method

In the case of the cork box none were needed. The box contains an electric heater and an electric fan, which gives us a means of heating the air in the box thoroughly and uniformly and of determining the amount of heat necessary to maintain any predetermined temperature difference between the air in the box and the room outside.

Boxes were constructed of the Nonpareil Cork and the Lith, the thickness of the material being two inches and the inside dimension of the cubical boxes being thirty-two inches. By means of an adjustable resistance inside each box and an auxiliary resistance outside, current and voltage could be maintained at any desired point. The temperature of the air inside the box and in the room outside was measured with thermometers of great precision, calibrated with care and known to be accurate to the nearest hundredth of a degree. These temperature measurements were also made by means of thermal junctions made of copper and nickel strips. These thermal junctions were also used in connection with the oil-box method



(Figure 6)
The hot-air boxes

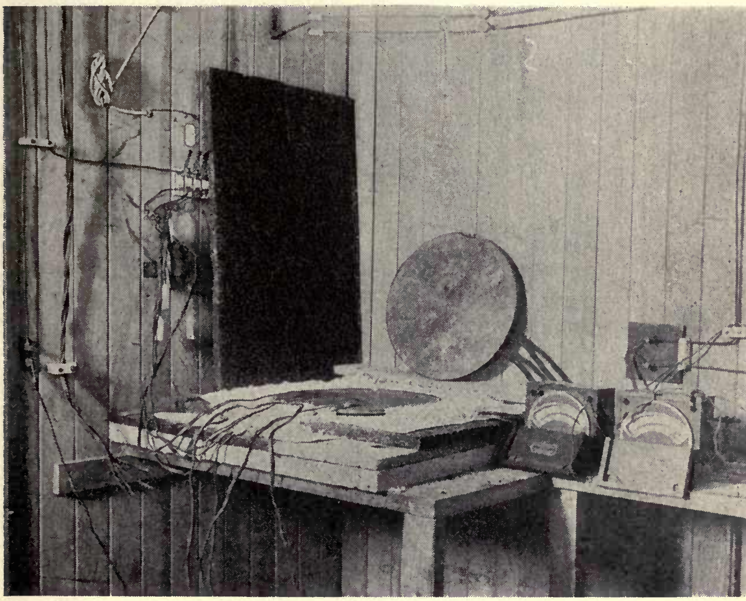
described above. The electrical instruments for both of these tests were calibrated and known to be correct. The results given by the "hot-air" box method are given below:

Nonpareil Cork........................6.9 B. T. U.
Waterproof Lith........................9.8 B. T. U.

The Flat-Plate Method

For a long time the writer has made measurements of the relative conductivity of heat insulators by what is known as the "plate" method. This has been used by a number of investigators to determine the absolute conductivity of numbers of substances. An electrically heated plate is placed between two sheets of the material to be tested, and outside of these sheets are placed two hollow flat plates cooled by a circulation of water. Except for the edges, the heat which is lost from the electrically heated plate goes through the specimens into the water-cooled plates. This heat may be measured electrically, the temperature difference between the hot plates and the cold plates can be readily measured by thermal junctions; and knowing these factors, the area and the thickness, we may compute the thermal conductivity of the material under test.

The difficulty with this apparatus lies in the determination of the loss from the edges, which is not only considerable but somewhat variable in amount, according to the nature and thickness of the material tested. A number of months of constant experimenting have enabled us to determine this loss from the edge and results obtained by this method with this



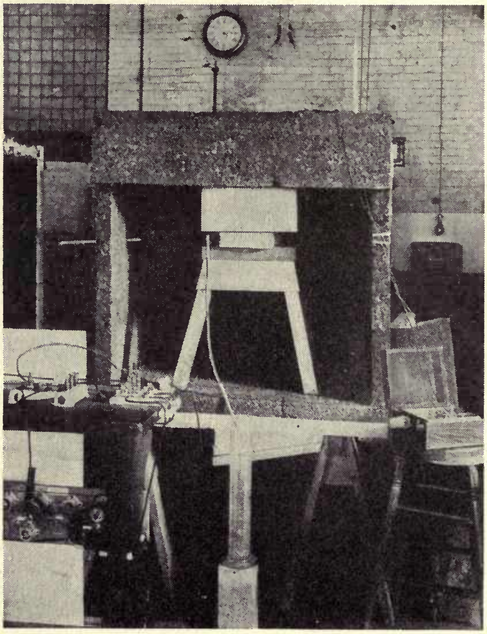
(Figure 8)
Apparatus for flat-plate test

correction compare very favorably with the data obtained by other methods; and we find the values of the thermal conductivity of the two substances under test to be as follows:

Nonpareil Cork........................6.7 B. T. U.
Waterproof Lith......................9.0 B. T. U.

The Cold-Air Box Method

The last method used, perhaps best described as the "cold-air" box method, consists merely in substituting for the electric heater and fan, a box of cracked ice hung inside the 32-inch cube near the top. This will maintain the air in the box at a much lower temperature than the room outside and since the amount of heat required by one pound of ice in melting is accurately known, we can determine the amount of heat which penetrates the walls of the box by weighing the water resulting from the melted ice. This is carried outside of the box through a small rubber tube. The difference in temperature between the air inside and outside of the box is measured by thermometers, and it has been found that with the ice-box suspended



(Figure 7)
The cold-air box method

near the top of the cube the natural circulation of air in the box keeps it at a very nearly uniform temperature. The results of tests give the following values:

Nonpareil Cork........................6.0 B. T. U.
Waterproof Lith........................9.7 B. T. U.

Discussion of Results

	B.T.U. by Ice-box Method	B.T.U. by Oil-Box Method	B.T.U. by Hot-Air Box Method	B.T.U. by Cold-Air Box Method	B.T.U. by Flat-Plate Method	B.T.U. Average
Nonpareil Cork	6.1	6.4	6.9	6.0	6.7	6.4
Waterproof Lith	7.9	8.4	9.8	9.7	9.0	8.9

It will be seen from an examination of the values of the thermal conductivity obtained by the different methods that there is no very great difference between the results obtained upon the same material by the several methods. In the opinion of the writer, however, these figures cannot be depended upon to give an absolute value of the thermal conductivity of the material as used in practice with a precision better than five per cent. In fact, the variations between several samples of the same material are likely to be as great as five per cent and oftentimes amount to ten per cent. The figures tabulated probably approximate very closely to the actual amount of heat which is lost per inch of thickness of insulation per square foot in twenty-four hours when there is one degree difference between the sides of the sheet. **Discussion of Results**

The experiments were carried out over sufficient ranges in temperature running from 32° Fahrenheit to 150° Fahrenheit, to enable us to be certain that the thermal conductivity of the materials does not vary much with the temperature. For instance, tests made between 32° and 70° give practically the same results as those made upon the same material between 70° and 100°. Further, the writer has recently made a study of the variations in thermal conductivity of a number of substances from zero up to 2,000° Fahrenheit and in view of these results it would be surprising if the variation in thermal conductivity between 32° and 100° should be found to be large enough to have any bearing upon this discussion.

The tests upon the ice-box are complicated by the fact that the proportion of corners to flat sides is larger than in the case of the 32-inch cube used in the hot-air method. This gives us some uncertainty as to what we should adopt as the real area of the insulation. In all cases, however, the mean area has been adopted—that is, the area of the surface taken at the middle of the thickness of insulation.

For a number of reasons it has seemed that the most reliable methods were the electrical method, using the hot-air box; and the cold-air box method. It will be seen that these two methods enable us to work readily upon a specimen containing fifty square feet. By using the electric heater we may have a higher temperature inside than outside. By substituting the box of ice we may reverse this temperature condition. By the electrical method we measure our heat in electrical units with delicate instruments and in the other method we measure the heat merely by weighing the amount of ice melted. In the one case the air is forcibly circulated by fans; in the other we depend upon the natural circulation of the cooled air; yet these two methods give us practically the same value for the amount of heat transmitted and it is the opinion of the writer that these two methods may well be adopted for tests of this sort of insulation.

The electrical flat-plate method is undoubtedly capable of yielding the most precise results. It is quite possible to duplicate observations by this method well within one per cent, but the uncertainty of the contact between materials to be tested and the large size which the apparatus must have in order to be usable for specimens two inches or more thick, and the accompanying uncertainty as to the heat lost from the edges, make the apparatus more suitable for determinations of the relative than for the absolute conductivity.

Examination of the results will show that the Nonpareil Cork is more effective as an insulator than the Waterproof Lith of the same thickness, and that there were greater variations in the values obtained in testing the Lith than was found to be the case with the Cork. This latter is undoubtedly due to the less rigid nature of the material, which makes it difficult to construct small test boxes without some danger of compressing the material. Further, it is more difficult to make perfectly tight joints with the Lith than with the Cork.

Best Representative Values

The best representative values of the heat transmitted through the two materials are, in the opinion of the writer, 6.4 B. T. U. for the Nonpareil Cork and 8.9 B. T. U. for the Waterproof Lith. This shows a difference of 2.5 B. T. U. If the efficiency of the Cork be taken as 100%, the efficiency of the Lith becomes 72%, and if the heat transmitted through the Lith be taken as 100%, then the efficiency of the Cork is 139%; that is, the Cork is 39% more efficient than the Lith or the Lith is 28% less efficient than the Cork, according to which is taken as the standard.

The material tested was obtained by purchase and samples were secured directly from the manufacturers. There is no question in the mind of the writer but that the materials tested were representative of the product sold under the designations used above.

The accompanying illustrations will indicate the details of the apparatus used. Figure 1 shows a cross-section of the ice-boxes used and Figure 5 shows the outward appearance. Figure 2 is a cross-section of the oil-box used and this is shown in photograph in Figure 3. Figure 4 shows a cross-section and Figure 6 a general view of the hot-air box. Figure 7 is a photograph of the cold-air box as used and Figure 8 shows the flat-plate tester opened up so as to show the hot and cold plates.

The Illustrations

Respectfully submitted,

(Signed) CHARLES L. NORTON

Report on Tests of Star Corkboard and Rock Cork

By PROFESSOR CHARLES L. NORTON

Boston, December 22, 1910

Pursuant to your request, I have made a series of tests to demonstrate the relative efficiency of the following insulating materials:

The Materials

No. 1. ROCK CORK. Apparently a fibrous slag wool board somewhat compressed and subsequently saturated or impregnated.

No. 2. STAR CORK. Which appears to be a granulated corkboard bound together with pitch or rosin.

The materials were bought in the open market and tested by four different methods, all of which are described in detail in my previous report on tests of Nonpareil Corkboard and Waterproof Lith, dated February 7, 1910. Two of the methods used were electrical, the other two of the so-called "melting ice" type. In the tables below, I have inserted, for purposes of comparison, the transmission values for Nonpareil Corkboard, given in my previous report.

Four Methods

Using the electrically heated box in the shape of a thirty-six-inch cube, the following values were obtained:

The Hot-Air Box Method

Rock Cork	9.65 B. T. U.
Star Cork	9.5 B. T. U.
Nonpareil Corkboard	6.9 B. T. U.

per one degree F. per one inch thickness per square foot per twenty-four hours.

The Flat-Plate Method

The second electrical method in which flat plates of the material were tested when in contact with an electric heater on one side and a cold-water plate on the other, gives the following values:

Rock Cork	9.9 B. T. U.
Star Cork	9.6 B. T. U.
Nonpareil Corkboard	6.7 B. T. U.

The Ice-Box Method

The first ice-box method, in which a twelve-inch cubical box of galvanized iron is jacketed on all sides with the materials to be tested and the amount of ice melted during each twenty-four hours is noted, gives the following values:

Rock Cork	8.7 B. T. U.
Star Cork	8.3 B. T. U.
Nonpareil Corkboard	6.1 B. T. U.

The Cold-Air Box Method

The second melting ice method, in which the electric heater is replaced by a box of ice inside the thirty-six-inch cube, gives the following values:

Rock Cork	8.4 B. T. U.
Star Cork	8.3 B. T. U.
Nonpareil Corkboard	6.0 B. T. U.

Summary of Results

The averages of the results obtained by the four methods are as follows:

Rock Cork	9.1 B. T. U.
Star Cork	8.9 B. T. U.
Nonpareil Corkboard	6.4 B. T. U.

Discussion of Results

As to the precision of the results, it may be said that the continuous testing which has been carried on for the past year has enabled us to make certain refinements in the processes which have improved the precision of the methods somewhat. However, the variation between separate samples of the same material is so great that no precision better than five per cent can be expected in work of this sort upon this kind of materials.

The duration of the tests has been greatly prolonged and no one of these values was determined without tests running through from fifteen to twenty days. It was found absolutely necessary to prolong the length of the runs in order to establish beyond any doubt the true thermal balance.

The range of temperatures used was from 32° to a maximum of 80° F.

You may be interested to note that I have tested within the last six months four specimens of Nonpareil Corkboard submitted to me by prospective purchasers and architects and that the values obtained range only from 6.3 B. T. U. to 6.7 B. T. U. **Other Tests on Nonpareil Corkboard**

Respectfully submitted,

(Signed) C. L. NORTON

From the foregoing report it appears that, if the efficiency of the Nonpareil Corkboard be taken as 100%, the efficiency of the Star Cork becomes 72%, and if the efficiency of the Star Cork be taken as 100%, then the efficiency of the Nonpareil Corkboard is 139%; that is, the Nonpareil Corkboard is 39% more efficient than the Star Cork or the Star Cork is 28% less efficient than the Nonpareil Corkboard, according to which is taken as the standard. **Comparative Efficiency of Star Cork**

If the efficiency of the Nonpareil Corkboard is taken as 100%, the efficiency of the Rock Cork becomes 70%, and if the efficiency of the Rock Cork be taken as 100%, then the efficiency of the Nonpareil Corkboard is 142%; that is, the Nonpareil Corkboard is 42% more efficient than the Rock Cork or the Rock Cork is 30% less efficient than the Nonpareil Corkboard, according to which is taken as the standard. **Comparative Efficiency of Rock Cork**

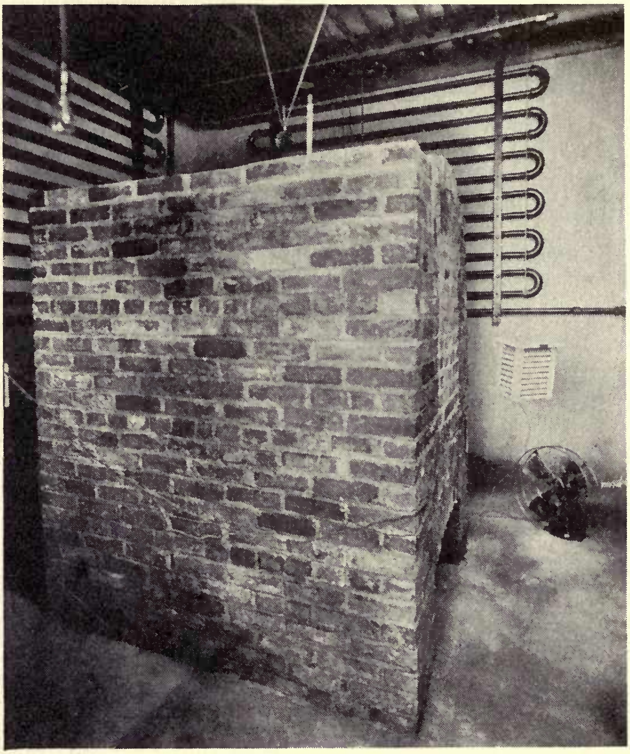
It is surprising to note how closely the Company's engineers, Mr. Kennedy, and Professor Norton, agree with each other in their determination of the heat conductivity of Nonpareil Corkboard: **Results Compared**

Company's Engineers	6.2 B. T. U.
Mr. Kennedy	6.5 B. T. U.
Professor Norton	6.4 B. T. U.

Extensive experiments made by Professor J. A. Moyer at the Thermal Testing Plant of Pennsylvania State College, State College, Pa., during 1913-14 lend additional confirmation to the accuracy of these figures. The slight differences are accounted for by variations in the density of the raw cork. **Confirmed by Pennsylvania State College Tests**

Tests on Building Materials

At the Company's testing station at Beaver Falls, a long series of tests has been made, not only on various forms of insulation but also on building materials such as brick and concrete. From the data thus obtained, the heat loss through any type



Test box built of brick with walls thirteen inches thick

of construction can be computed accurately, and the proper thickness of insulation to install, determined on a thoroughly scientific basis. The following table gives some of the results, the tests marked with a dagger (†) having been made by Mr. Walter Kennedy at Pittsburgh, while those marked with an asterisk (*) were conducted by Professor Norton in the laboratories of the Massachusetts Institute of Technology at Boston:

Material	Thickness	Transmission in B.T.U. per Sq. Ft. per Deg. F. diff. in Temperature for 24 Hours	Transmission in B.T.U. per Sq. Ft. per Deg. F. diff. in Temperature per 1 in. thickness for 24 Hours	Year Test Was Made
Composition Corkboard	2-inch	4.2	8.4	1907
(Granulated cork and	2 "	4.5	9.0	1907
asphalt)	† 2 "	4.5	9.0	1909
	† 2 "	4.4	8.8	1909
Average of 4 Tests			8.8	
*Star Corkboard	2-inch	----	9.5	1910
* " "	2 "	----	9.6	1910
* " "	2 "	----	8.3	1910
* " "	2 "	----	8.3	1910
Average of 4 Tests			8.9	
Lith	2-inch	3.8	7.6	1907
"	2 "	3.7	7.4	1907
"	2 "	3.7	7.4	1907
"	2 "	3.8	7.6	1907
"	2 "	3.8	7.6	1907
† "	2 "	4.0	8.0	1909
† "	2 "	3.9	7.8	1909
Average of 7 Tests			7.6	
†Waterproof Lith	2-inch	4.2	8.4	1909
† " "	2 "	4.2	8.4	1909
* " "	2 "	----	7.9	1910
* " "	2 "	----	8.4	1910
* " "	2 "	----	9.8	1910
* " "	2 "	----	9.7	1910
* " "	2 "	----	9.0	1910
Average of 7 Tests			8.8	
†Rock Cork	2-inch	3.8	7.6	1909
† " "	2 "	3.6	7.2	1909
* " "	2 "	----	9.65	1910
* " "	2 "	----	9.9	1910
* " "	2 "	----	8.7	1910
* " "	2 "	----	8.4	1910
Average of 6 Tests			8.57	
†Indurated Fibre	2-inch	5.0	10.0	1909
† " "	2 "	5.0	10.0	1909
Average of 2 Tests			10.0	

*Tests made by Prof. C. L. Norton. †Tests made by Walter Kennedy, M. E.

Material	Thickness	Transmission in B.T.U. per Sq. Ft. per Deg. F. diff. in Temperature for 24 Hours	Transmission in B.T.U. per Sq. Ft. per Deg. F. diff. in Temperature per 1 in. thickness for 24 Hours	Year Test Was Made
Nonpareil Corkboard	1-inch	6.4	6.4	1907
" "	1 "	6.4	6.4	1907
" "	1 "	6.2	6.2	1907
" "	1 "	6.2	6.2	1907
" "	2 "	3.0	6.0	1907
" "	2 "	3.0	6.0	1907
" "	2 "	2.9	5.8	1907
" "	2 "	3.0	6.0	1907
" "	2 "	2.9	5.8	1907
" "	2 "	3.0	6.0	1907
† " "	2 "	3.3	6.6	1909
† " "	2 "	3.2	6.4	1909
" "	3 "	2.2	6.6	1907
" "	3 "	2.2	6.6	1907
* " "	2 "	----	6.1	1910
* " "	2 "	----	6.4	1910
* " "	2 "	----	6.9	1910
* " "	2 "	----	6.0	1910
* " "	2 "	----	6.7	1910
Average of 19 Tests			6.26	
1-inch Nonpareil Corkboard with ½-inch Portland Cement Pl.	1½-inch	5.9	----	1907
	1½ "	5.8	----	1907
Average of 2 Tests		5.85		
Brick Wall	13-inch	8.8	114.4	1908
" "	13 "	9.5	123.5	1908
" "	13 "	9.4	122.2	1908
Average of 3 Tests			120.0	
13-inch Brick Wall insulated with one layer of 2-inch Nonpareil Corkboard erected in ½-in. Portland Cem.	15½-inch	2.7	----	1908
	15½ "	2.8	----	1908
Average of 2 Tests		2.75		
13-inch Brick Wall insulated with two layers 2-inch Nonpareil Corkboard each erected in ½-in. Portland cement	18-inch	1.5	----	1908
	18 "	1.4	----	1908
Average of 2 Tests		1.45		

*Tests made by Prof. C. L. Norton. †Tests made by Walter Kennedy, M. E.

Material	Thickness	Transmission in B.T.U. per Sq. Ft. per Deg. F. diff. in Temperature for 24 Hours	Transmission in B.T.U. per Sq. Ft. per Deg. F. diff. in Temperature per 1 in. thickness for 24 Hours	Year Test Was Made
Concrete (1–3–5)	4-inch	25.5	102.0	1909
" "	4 "	26.0	104.0	1909
Average of 2 Tests			103.0	

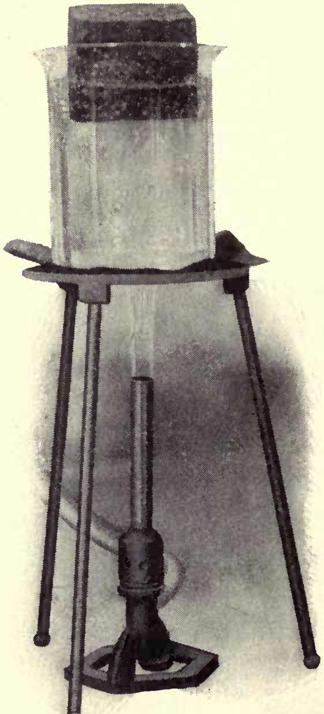
II. Nonpareil Corkboard is Nonabsorbent of Moisture and, Therefore, Durable in Service.

Moisture and Durability

While efficiency as a nonconductor of heat is obviously of the utmost importance in an insulating material, durability in actual service is just as essential, and durability in this connection, translated into the simplest terms, means merely the ability to resist moisture. Water is a good conductor of heat; hence, just as soon as any insulating material gets watersoaked, it becomes practically worthless as an insulator. Moreover, moisture causes rapid deterioration in the material itself. Therefore, thoroughly durable insulation must be waterproof in every sense of the word. When put to this test, nearly all the materials that, in a dry state, are good nonconductors of heat, may be weighed in the balance and found wanting. But here again Nonpareil Corkboard asserts its superiority. Properly erected, it will not become waterlogged; its tiny sealed air-cells will not absorb moisture.

The Navy Test on Nonpareil Corkboard

Take a piece of Nonpareil Corkboard that has been soaked in water, cut it open and you will find the granules dry inside. Or, if you prefer to do so, you can make a simple experiment yourself, which will demonstrate conclusively that Nonpareil Corkboard is the one type of insulation *that will keep* *itself dry.* The test is designed to concentrate in a short period of time those destructive forces to which all insulation is subject during its term of actual service, and in making it, you will simply be following the example of the United States Navy Department. Large quantities of Nonpareil Corkboard are used aboard war vessels for insulating powder magazines, cold storage rooms and living quarters, the government specifications providing that all corkboard used must withstand boiling for three hours at atmospheric pressure without going to pieces and without expanding more than two per cent in any direction.



Boiling test on Nonpareil Corkboard

Nonpareil Corkboard Remains Dry Inside

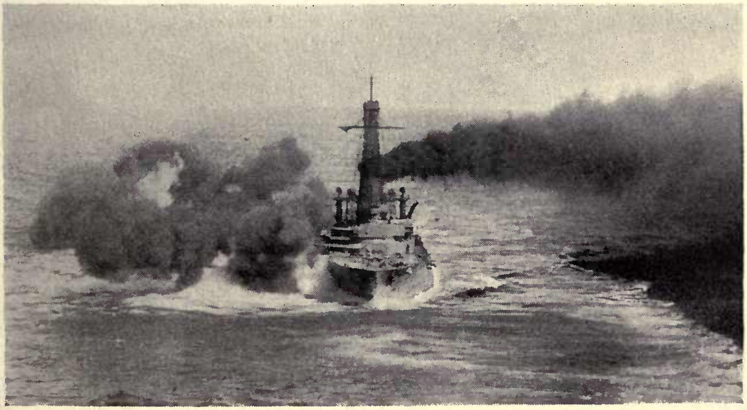
Break your sample of Nonpareil Corkboard in two and boil one piece for three hours. Weight it down, if you wish, so as to submerge it completely. Take it out, and you will find it still firm and none the worse for its experience. Now fit the two pieces together. See for yourself that the boiling water has caused little or no expansion. Then break open the granules of the boiled piece, and you will find them dry inside. Insulation that keeps dry, keeps efficient. Make the same experiment on other forms of insulation, and draw your own conclusions.

When a cold storage room is cooled down, the air confined in the insulation on the side next to the room gets cold and contracts. This produces a partial vacuum and the warm air outside endeavors to force its way in to restore equilibrium. It carries with it, of course, more or less moisture, which, when the air is cooled below the dew point, condenses and is deposited right in the heart of the insulation itself. This goes on, not at one moment, but constantly, day and night, during the whole time the plant is in use; and unless the insulation is really waterproof, it will soon reek with moisture.

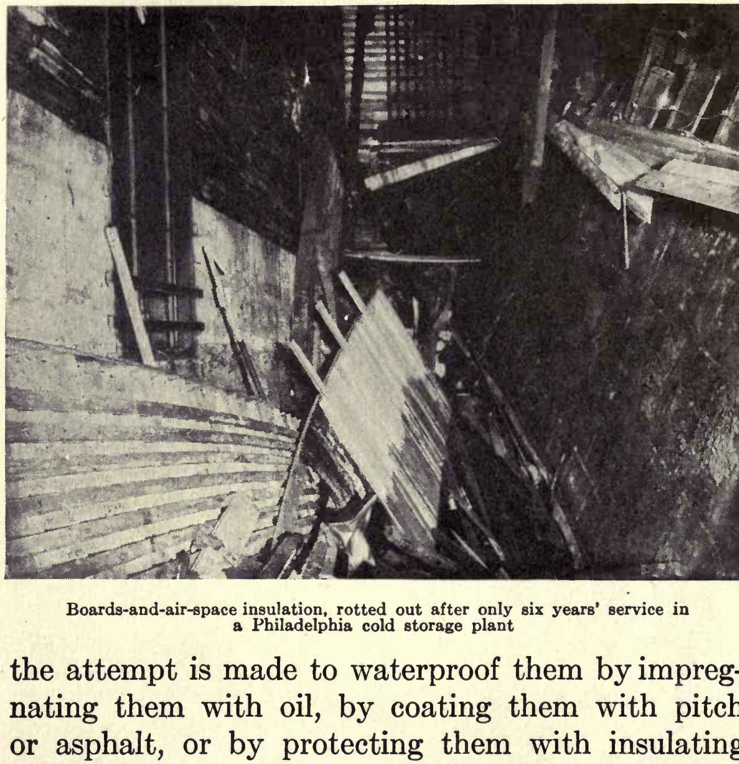
Condensation

This process is materially aided and hastened by the capillary attraction, i. e., the natural tendency to suck in moisture, common to all types of insulation of fibrous character, such as mineral wool, hair-felt, shavings, sawdust, cotton seed hulls, boards-and-air-space construction, etc. Furthermore, the

Capillary Attraction



U. S. S. North Dakota firing a salvo. Three carloads of Nonpareil Corkboard are installed on this vessel air-spaces in materials of this kind are not absolutely independent of each other, as are the cells in cork, but are merely voids between the closely-matted fibers. Hence, while such materials may be efficient when dry, it is well-nigh impossible to keep them in that condition. No matter how carefully

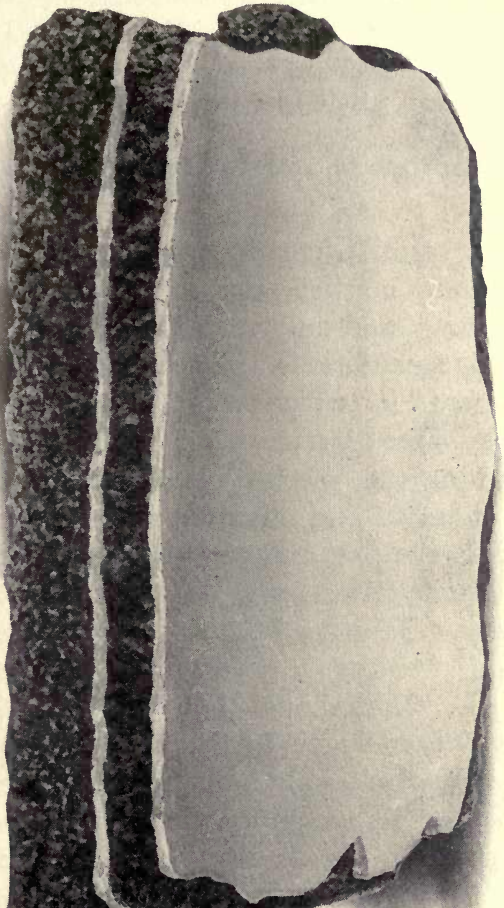


Boards-and-air-space insulation, rotted out after only six years' service in a Philadelphia cold storage plant

the attempt is made to waterproof them by impregnating them with oil, by coating them with pitch or asphalt, or by protecting them with insulating paper, sooner or later the warm air will effect an entrance somewhere, condensation will begin and before long the insulation will become watersoaked and inefficient. Eventually it will have to be torn out and replaced.

Nonpareil Corkboard Moisture Proof

Nonpareil Corkboard, on the contrary, will generally last as long as the building itself, if properly installed. The warm air cannot penetrate its tiny air-cells, for Nature seals them hermetically,



Section of Nonpareil Corkboard insulation after four years' service, taken from one of Swift & Company's coolers, Philadelphia, Pa., on account of alterations in the building. The insulation, as shown, consisted of one course of two-inch and one of one-inch Nonpareil Corkboard, both erected in Portland cement mortar, with Portland cement plaster finish. On its removal, the corkboard was found to be in as dry and perfect condition as the day it was put in.

completely isolating each one from the myriads of others. Each granule of cork, moreover, is covered with a waterproof coating of the natural rosin, liquified and brought to the surface by the baking process. Hence, there is no capillary attraction, no absorption of moisture, no progressive deterioration. Experience has shown that Nonpareil Corkboard, erected properly, will last indefinitely.

III. Nonpareil Corkboard is Sanitary and Odorless.

Everyone knows how susceptible delicate food stuffs, such as milk, cream, butter, eggs, ice cream, etc., are to any marked odor, and how essential it is that they be stored only under thoroughly sanitary and hygienic conditions. The insulation of every storage room, in which such goods are carried, should, therefore, be practically odorless to begin with; and in the second place, should be proof against rot, mold and offensive odors generated by decay. For the first reason, the use of corkboard in which pitch serves as a binder is apt to result disastrously. Tainting is almost sure to follow its installation, for the odor of pitch is particularly penetrating. Nor should hair-felt, or any other animal substance be employed, for it inevitably gets damp, decays and sometimes becomes exceedingly offensive. Boards-and-air-space construction, shavings, sawdust, cotton seed hulls, etc., mold and rot out. All such types of insulation, moreover, afford excellent harboring places for rats, mice, and other vermin, render the maintenance of hygienic and sanitary conditions impossible, and largely increase the danger of fire.

Danger of Taint

Harboring Places for Vermin

Nonpareil Corkboard, on the other hand, will not rot, mold or give off offensive odors. Properly erected, it is vermin-proof. Rooms insulated with it, with Portland cement plaster finish, are easily

Nonpareil Corkboard Ensures Sanitary Conditions kept in sanitary and hygienic condition. They may, in fact, be washed down with a hose as often as necessary, without affecting the insulation in the slightest. This last point is of great importance where citrus fruits, or anything else that gives off a marked odor, are handled. In such cases, it is essential that the storage rooms be entirely freed of the odor before other goods are placed in them; otherwise, tainting is sure to take place. To accomplish this speedily is frequently very difficult, but with Nonpareil Corkboard insulation, the objectionable condition can be readily and promptly overcome.

Pure Food Legislation

Pure food legislation requires the maintenance of a high standard in the manufacture and distribution of food products—a higher standard perhaps than has generally prevailed in the past. Although practically all the industries in which refrigeration is used have felt the effects of such legislation, the fact that Nonpareil Corkboard ensures and renders easy the maintenance of sanitary and hygienic conditions, is of particular importance to the dairyman, the creamery man, the baker, the candy maker, the ice cream manufacturer and the cold storage warehouseman.

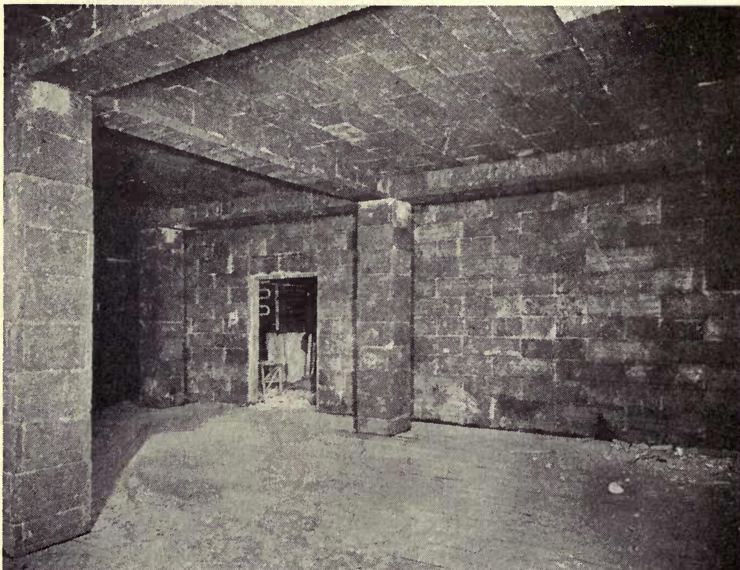
IV. Nonpareil Corkboard is Compact, Occupying but Little Space.

Saving in Storage Room

On account of its low heat conductivity and the solid and compact construction which it renders possible, Nonpareil Corkboard insulation requires but little space, and thus saves storage room. The importance of this phase of the question is frequently overlooked, but an illustration will show how important it really is:

A Concrete Example

Let us assume that in a cold storage warehouse there is a room to insulate, measuring twenty by thirty by ten feet high, designed to hold a temperature of 10° F. above zero. This would require five inches of Nonpareil Corkboard (six and one-half inches with cement mortar and plaster finish), or



Nonpareil Corkboard erected in Portland cement mortar against the walls, columns and ceiling in John F. Jelke Company's plant, manufacturers of butterine, Chicago, Ill. Notice the solid, substantial construction.

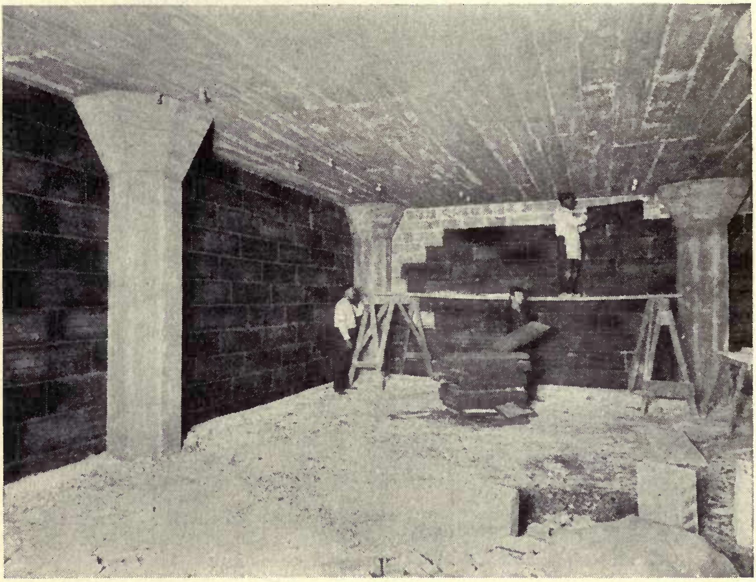
seventeen inches of boards-and-air-space construction, i. e., twelve boards and five air-spaces, which construction would be about equivalent in insulating efficiency to the five inches of Nonpareil Cork. By installing the corkboard, ten and a half inches would be saved all around the room; or in other words, 1535 cubic feet of storage space, or 25.5% of the gross cubical contents of the room. In a warehouse where the first cost of space including land value is forty cents a cubic foot, this space would be worth $614.00, and would yield, at two cents a cubic foot for six months in the year, an annual return of $184.20. Furthermore, the boards-and-air-space insulation would cost just as much at the present prices of lumber, if not more, than the five inches of cork-

Nonpareil Corkboard erected in asphalt cement and nailed in place in the hold of the famous clipper ship, "Glory of the Seas," now turned into a floating cold storage plant. Notice how the corkboard has been fitted to the irregular wall surfaces.

board, and besides, would rot out and have to be renewed every six or seven years. The space saved by installing Nonpareil Corkboard will, in itself, go quite a long way to offset the initial cost.

V. Nonpareil Corkboard is Structurally Strong and Therefore, Easy to Install.

The structural strength of Nonpareil Corkboard and the ease with which it may be erected are two of the strongest points in its favor. It may be cut, **Strong and Easily Erected** sawed and nailed into place just as lumber in buildings of frame construction, or put up with equal readiness in Portland cement mortar against brick, stone, concrete, or hollow tile walls and ceilings. It requires no external supports or retaining walls to hold it in place. Solid Nonpareil Corkboard partitions as high as twenty-four feet are readily erected



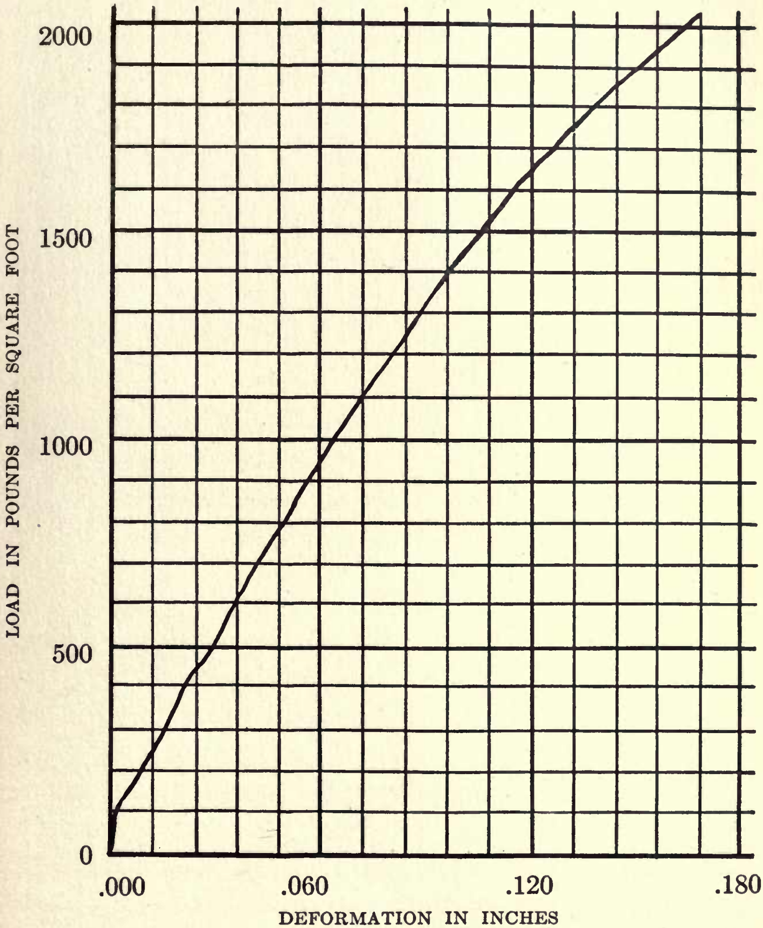
Erecting Nonpareil Corkboard against tile wall with Portland cement mortar. Merchants Ice & Cold Storage Co., Cincinnati, O.

without the use of any studding whatsoever. They save space and the cost of lumber otherwise required. In insulating floors and the bottoms of freezing tanks, Nonpareil Corkboard is laid down in asphalt. Its strength in compression is ample to take care of loads many times greater than those ordinarily encountered. (Note the graphic chart on page 53).

Portland cement plaster adheres perfectly to its surface, affording a sanitary and hygienic finish.

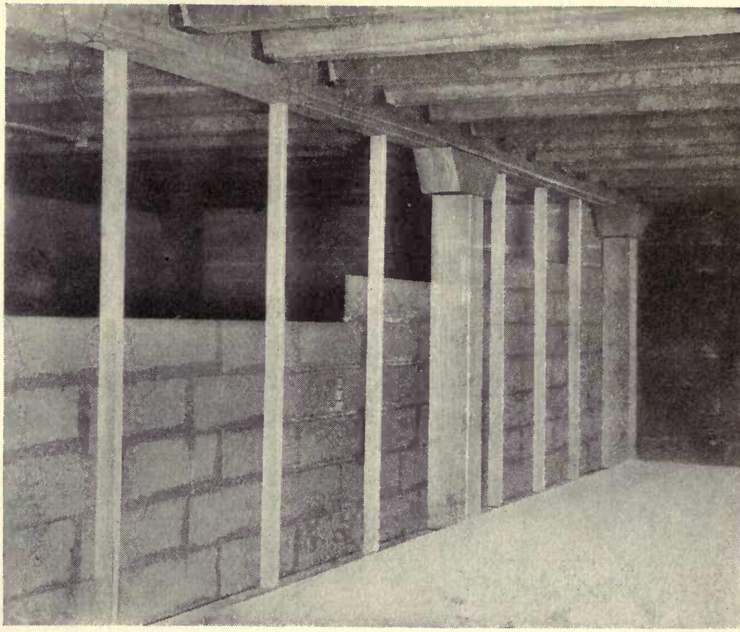
Other Corkboard Structurally Weak

All this cannot be said about other types of insulation in sheet form. Those forms of corkboard



Compression test on Nonpareil Corkboard made in August 1915. The tested specimens were 6 inches x 6 inches x 2 inches thick and were tested flat.

in which glue, asphalt, or pitch is used as a binder are apt to disintegrate in time, particularly when applied against wooden ceilings. The weight of the



Erecting solid cork partitions at Newark Ice & Cold Storage Company's plant, Newark, Ohio. In building partitions of this kind temporary studs are used to guide the workmen. When the partition is completed, the studs are removed.

plaster and the corkboard itself tends to pull the nails through the sheets; the corkboard drops away, and the nails are left sticking in the sheathing. In Nonpareil Corkboard, the natural gum or rosin of the cork itself serves to bind the whole mass together securely. This natural binder is proof against moisture. Hence the board will not disintegrate, and as it is firm and tough, it can be nailed against ceilings with the assurance that the nail heads will not pull through.

Mineral Wool Blocks Unstable

The difficulties met with in handling mineral wool boards are many. To begin with, the material itself is unstable and requires the admixture of some fibrous binder to give it any structural strength at all. It cannot be erected with Portland cement satisfactorily, as each block must first be coated with asphalt to waterproof it, and the bond which results between the surface covered with asphalt and Portland cement is not of sufficient strength. When nailed against studding or sheathing, roofing washers or large pieces of expanded metal lath have to be used about the heads of the nails, to prevent them from pulling through. It is a disagreeable material to handle, as the fine particles get into the hands and even into the nose, eyes and lungs, sometimes causing serious trouble.

Relative Structural Strength

To test the relative structural strength of Nonpareil Corkboard and mineral wool blocks is a very

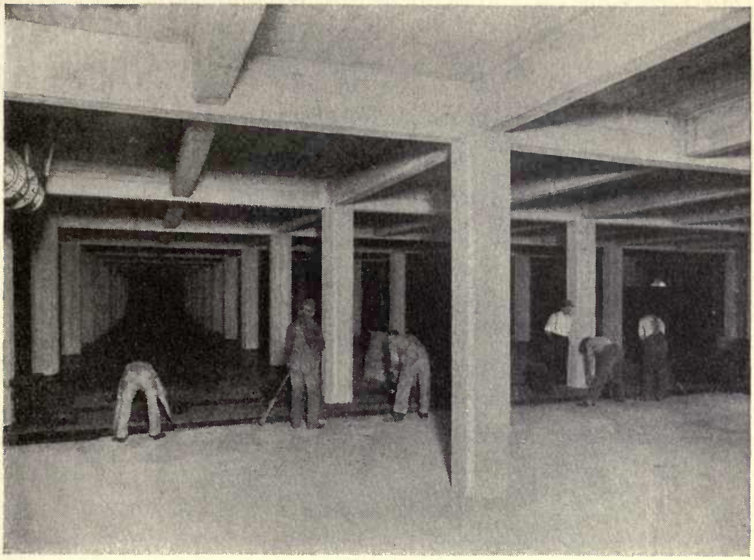
In erecting Nonpareil Corkboard against concrete ceilings, the boards are coated with Portland cement mortar and propped in place until the cement sets. This view was taken at the St. Louis Refrigerating & Cold Storage Company's plant, St. Louis, Mo.

simple matter. Lay a sheet of each up against a concrete (or brick) wall in Portland cement mortar and after the cement sets, try pulling the boards down. When you get through, no doubt will be left in your mind as to which gives the stronger and more substantial construction. As a matter of fact, the strength of the bond between Nonpareil Corkboard and concrete is remarkable, as the following test gives evidence:

Test of Bond Between Nonpareil Corkboard and Concrete

Two pieces of 3-inch Nonpareil Corkboard, each measuring 12 inches x 18 inches, were used. Grooves were made in one side of each board, so as to permit two iron bars, 5¼ inches (center to center) apart, running lengthwise, to lie flush with its surface. In these bars, which were 1¼ inches wide, ⅜ inch thick, and 18 inches long, two holes were drilled and tapped nine inches apart. Corresponding holes were made in the corkboard so that hooks might be screwed into the bars from beneath. By this means the load was distributed over the entire area of contact between the cork and the concrete, when weights were attached to the hooks. Concrete four inches thick was then poured on the corkboard, the concrete being composed of one part of Portland cement, three parts clean, sharp sand, and five of crushed stone. After it had thoroughly set for twenty days, the concrete slab with the corkboard attached was placed on supports; the hooks were screwed into the bars and weights added gradually. Two tests showed that it required an average of 344 pounds per square foot to break the bond between the corkboard and the concrete.

All loose insulating materials—granulated cork, mineral wool, sawdust, shavings, cinders, cotton



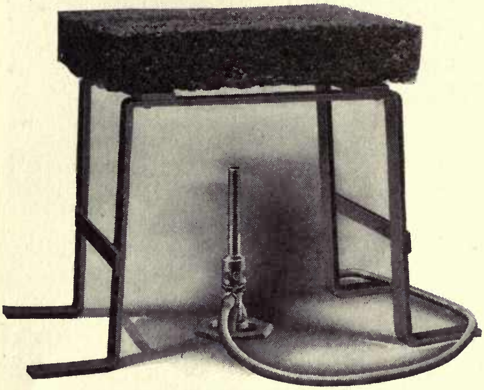
Insulating a floor with Nonpareil Corkboard at the Morris Cold Storage Company's plant, Chicago, Ill. The boards are laid down in hot asphalt, the surface flooded with the same material and the wearing floor laid directly on top.

seed hulls, etc.—are at a distinct disadvantage when compared with Nonpareil Corkboard, on account of the retaining walls or sheathing that they require to hold them in place, an item which naturally increases the cost of construction. It is, moreover, impossible to render them moisture-proof, and every one of them, with the exception of granulated cork, will inevitably become waterlogged. Another serious objection lies in the fact that they are all bound to settle; furthermore, if a break occurs in the retaining wall, part of the filler is apt to run out, in either event leaving spaces here and there empty and unprotected.

Specifications and drawings showing the various methods used in installing Nonpareil Corkboard will be found on pages 85 to 121. Note also the "Structural Suggestions" on pages 73 to 83.

VI. Nonpareil Corkboard is Slow-Burning and Fire-Retarding.

Nonpareil Corkboard is first, slow-burning, as ignited cork will not support combustion in the absence of heat applied from some external source; and second, fire-retarding, since the solid and compact construction that it permits, unlike old methods, leaves no concealed air-spaces in the walls to act as flues and assist in the spread of a fire once under way.



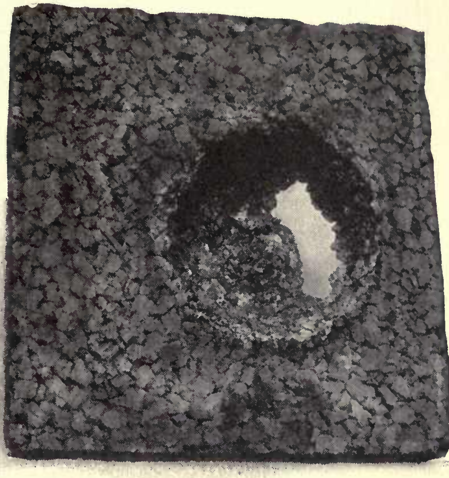
Apparatus for simple fire test

A Simple Experiment with Nonpareil Corkboard

Anyone can readily determine the relative slow-burning qualities of Nonpareil Corkboard as compared with other forms of insulation by a simple experiment. All that is needed is an iron stand, a burner, and pieces of the different materials, say, twelve inches square and two inches thick. Place each piece on the stand, as indicated in the accompanying illustration. Record the time it takes to burn a hole clear through, and carefully note the condition of each specimen at the expiration of this period. The cut on the next page shows the appearance of a piece of Nonpareil Corkboard after a 1500° F. flame had been burning under it for four hours and five minutes. It took just that long for the flame to burn through. Notice that it did not spread out or char the under surface.

The other picture shows what was left of a piece of fibrous compressed mineral wool block of the same size and thickness after the same flame had been applied for but two hours and five minutes. When lifted from the stand it simply fell to pieces. If you will also test the other kinds of corkboard on the market, you will readily appreciate why the underwriters have given their approval to corkboard of the Nonpareil type and to no other form of cold storage insulation.

The Same Experiment with Other Materials



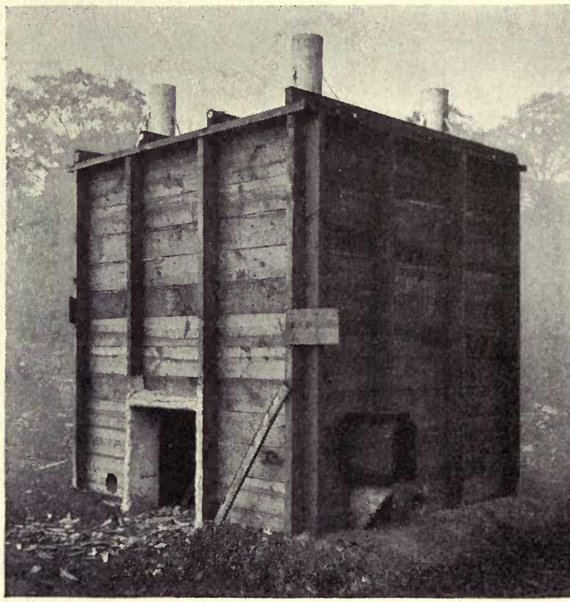
Two-inch Nonpareil Corkboard after 1500° F. flame had been applied for four hours and five minutes

An elaborate test made at Beaver Falls, Pa., on August 24, 1907, demonstrates in striking fashion its fire-retarding properties. A room eight feet square and eight feet high was constructed of two by four-inch studs, sheathed on the inside with ordinary one-inch lumber. The walls and ceiling were insulated with two courses of two-inch Nonpareil Corkboard, both erected in Portland cement with one-half inch Portland cement plaster finish.

A Remarkable Fire Test

Fibrous compressed mineral wool block after 1500° F. flame had been applied for two hours and five minutes

The Procedure After the cement has thoroughly set, the room was filled with a mass of combustible material—firewood, kerosene, etc. Several small holes around the base and the opening through which the fuel was supplied, allowed the free ingress of air. As shown in the photographs, there were four flues,



Insulated room before the test

eight inches in diameter, one at each corner of the roof. The duration of the test was two hours. By means of a thermo-electric pyrometer, the temperature at two widely separated points inside the room was recorded at five minute intervals. The maximum temperature reached was 1937° F., but the outside of the walls never became heated. To the touch they were as cool at the end as at the beginning of the test. Finally the fire was extinguished by a stream of water thrown with considerable force not only on the mass of burning material but also on the walls and ceiling.

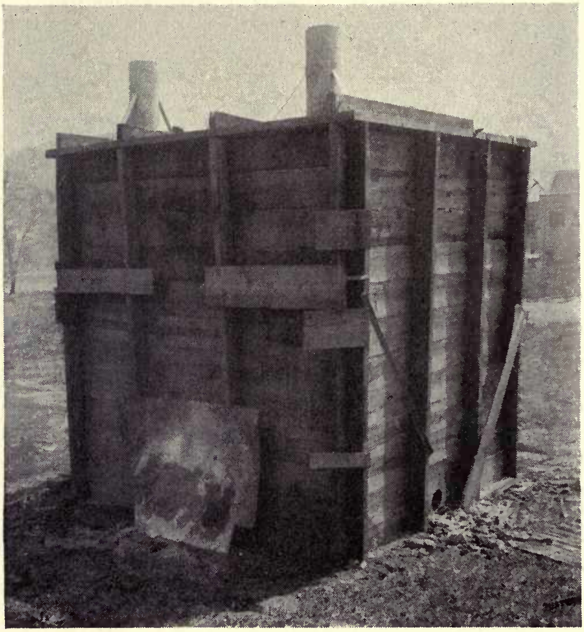
Examination revealed that the cement plaster had all fallen down, with the exception of a small amount around the edges of the walls and ceiling. The Results

The fire at its height

The outer course of corkboard had been charred almost all the way through but still remained clinging to the cement mortar between the two layers. The fire had carbonized the cork, and the layer of carbon, itself a good insulator, had shielded the part beneath. The cement mortar between the two layers and the under course of corkboard were not affected in any way. The pictures of the room after the test and a cross-section of one of the walls at close range, verify this assertion.

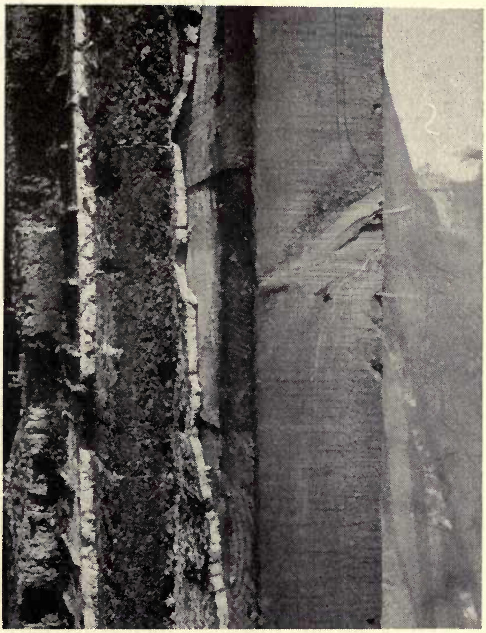
Actual Fires

Nor are demonstrations of what corkboard will do in actual fires lacking. The only thing, in the opinion of the architect and the fire insurance adjusters, that saved the walls of the cold storage



The insulated room at the conclusion of the test

building of the Zoller Packing Company, Pittsburgh, Pa., when the rest of the plant was destroyed in April 1907, was the two layers of two-inch corkboard insulation. Successfully withstanding the intense heat generated by thousands of pounds of lard and other combustible materials, the corkboard remained clinging to the walls, preventing the flames from reaching the brick, calcining them and thus causing utter collapse. As it was, while the whole of the interior of the building was burned out, the four walls remained intact. When the plant was rebuilt, they were utilized again, together with almost all of the under course of corkboard, which was undamaged.



Cross sectional view of wall of room after the test, showing from right to left—studding, sheathing, cement back, under course of corkboard, the cement between, and outer layer of corkboard shriveled by the heat.

Instances of this kind could be multiplied. For example, on December 3d, 1914, a fire, which lasted nine hours and entailed a loss of $50,000, took place in the store of Mr. A. Weber, a grocer, in Kansas City, Mo. Everything of value in the basement, including the refrigerating machinery, was ruined, with the exception of the cold storage room. Here, although the Portland cement plaster on the cork- **Fire at Weber's Grocery Kansas City, Mo.**

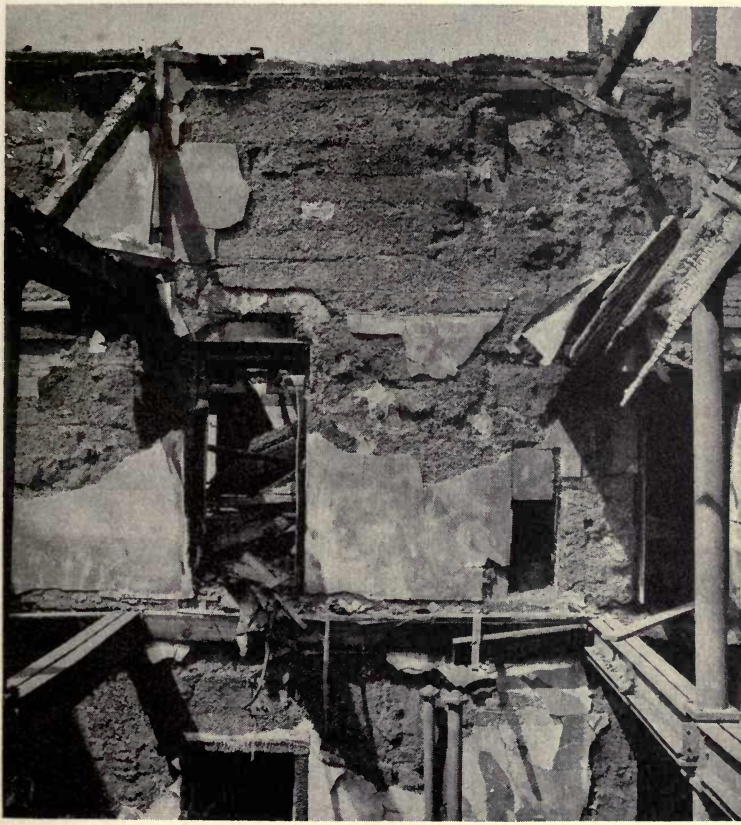
board was destroyed and the door burned part of the way through, the insulation, which consisted of two courses of two-inch Nonpareil Corkboard, was practically undamaged. Immediately above, on the main floor, was a large cold storage room. The fire was so intense that this floor, which consisted of

Cold storage building of Zoller Packing Company, Pittsburgh, Pa. after the fire of April, 1907. The interior was completely gutted, as shown by the view on the following page.

heavy wooden joists with two courses of lumber and a petro-pulp wearing surface, was practically destroyed, a large portion falling through to the basement. Despite this fact, the temperature in the room on this floor—situated immediately over the hottest part of the fire—was found to be only 38° F., and the frost still remained on the pipes, fifty hours after the blaze started. The engineer in charge stated positively that this represented a rise

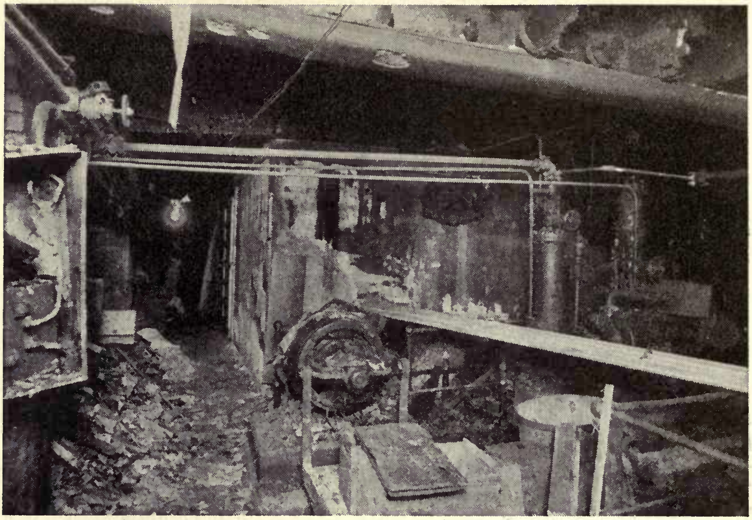
Frost Even Remained on Pipes

of only 10° from the time the machinery was shut down. Finding his cold storage rooms in such excellent condition inside, Mr. Weber at once made application for street line refrigerating service from



Interior of cold storage building shown on the preceding page. The corkboard may be seen still firmly attached to the wall.

the Missouri Valley Cold Storage Company, rented a store room adjacent to his former location and was doing business as usual the following morning. Other cases in which Nonpareil Corkboard has proved its efficacy as a fire-retardant will be supplied on application.



Basement of Weber's Store, Kansas City, Mo., after the fire. The walls of the cold storage room may be seen in the background.

Approved by the National Board of Fire Underwriters

In view of its showing in actual fires, it is not surprising that Nonpareil Corkboard is approved by the National Board of Fire Underwriters. Approval was given only after an exhaustive test conducted by the Underwriters Laboratories, Inc., Chicago, Ill., on November 7th, 1907. A section of wall insulated with two courses of two-inch Nonpareil Corkboard, both erected in Portland cement mortar, with a Portland cement plaster finish, not only withstood intense heat, running as high as 2240° F., for one hour, but also a stream of water thrown against it at high pressure at the expiration of that time. The elaborate report describing this test in detail is on file in the offices of the National Board of Fire Underwriters in the following cities, and may be consulted on application: New York, Boston, Philadelphia, Newark, N. J., Syracuse, N. Y., Hartford, Conn., Chicago, St. Louis, New Orleans, Atlanta, San Francisco.

The official summary and approval, a synopsis of this detailed report, is given in full below. It may be found on file in the offices of all the underwriters' associations, fire insurance companies, and agencies that are subscribers to the National Board of Fire Underwriters:

The Underwriters' Report

191—March 4, 1908

Heat Insulating Coverings

Armstrong Cork Company, Manufacturers
Pittsburgh, Pa.

Corkboard (Nonpareil) Laid in Cement Mortar.

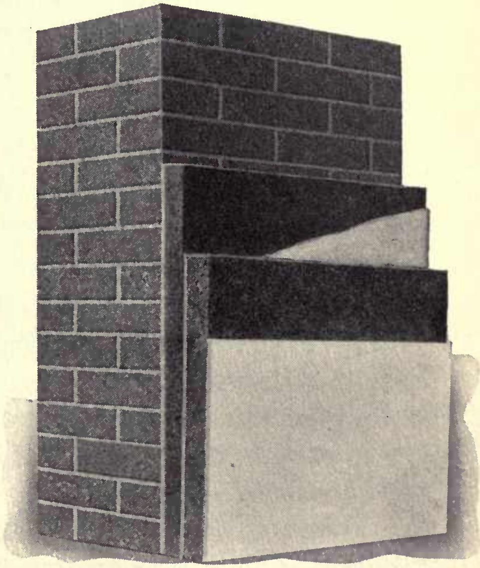
Heat insulating coverings for walls, floors and ceilings (not for steam pipes, stacks, etc.), of two-ply construction, consisting of two layers of two-inch Nonpareil Corkboard bedded in ½-inch layers of cement mortar and covered with a ½-inch finish coating of the same material.

Corkboard in sizes not exceeding 36 x 12 inches laid with joints broken in both directions. Cement mortar made of one part Portland cement and two parts clean, sharp sand.

Corkboard for floors laid in hot asphalt and covered with concrete three to four inches thick.

The above is APPROVED for heat insulating purposes for walls, floors and ceilings in cold storage warehouses, cold storage cellars in breweries, cold rooms in packing houses, hotel refrigerators, fur storage rooms and rooms of this character.

(Underwriters having jurisdiction to be consulted before installation.)



The type of construction approved by the Underwriters

Other Tests by Laboratories

The other two types of manufactured insulation most commonly met with, viz., fibrous mineral wool blocks, and composition corkboard, made of granulated cork and asphalt or pitch—have also been tested by the Underwriters Laboratories, both materials failing to meet the rigid requirements necessary for approval.

Mineral Wool Blocks Not Approved

The first test on fibrous mineral wool blocks was made early in 1909. The features criticized by the Laboratories were the lack of durability of the material when exposed to fire, its lack of resistance to fire streams, its structural weakness and combustibility. In August 1909, a second set of samples was submitted and tested. In this case the features criticized were the size of the boards and the combustibility of the material itself. The summary of the official report may be found on file in the offices of all the underwriters' associations, fire insurance companies, agencies, etc. that are subscribers to the National Board of Fire Underwriters.

Composition Corkboard Not Approved

Composition corkboard was tested in 1911, the features criticized being the lack of durability of the material when exposed to fire, its combustibility, and the amount of smoke it gives off when burning. The official summary of this test is also on file in insurance offices throughout the country.

Reduced Insurance Rates with Nonpareil Corkboard

The approval of Nonpareil Corkboard by the National Board of Fire Underwriters has resulted, in many sections of the country, in reduced insurance rates not only on buildings insulated with it, but on their contents as well. In the "Analytic System for the Measurement of Relative Fire Hazard" (1914 Edition), sometimes known as the "Dean Schedule," in which the rating of fire risks is put on a scientific basis, the difference in fire hazard between cold storage buildings insulated with corkboard of the approved Nonpareil type and other forms of insulation, is clearly recognized. In Items Nos. 5 and 6, under Section 322, pertaining to cold storage warehouses, it is provided that "compositions which contain vegetable fibre" (which covers mineral wool blocks containing an admixture of flax fibre), and "corkboard impregnated with combustible materials" (viz., composition corkboard made of cork and asphalt or pitch), shall take a 10% extra charge of the basis rate established for the type of building in which the insulation is installed; and that "air, sawdust, shavings, cotton seed hulls, or vegetable fibre insulation" shall take a 30% additional charge of the basis rate; whereas there shall be no extra charge for "pure corkboard" (viz., corkboard of the Nonpareil type containing nothing but pure granulated cork). Similar provisions are inserted in Section 222 relating to breweries.

These differentials apply on brick construction (not fire-proof), including brick, tile, stone, concrete and skeleton steel buildings, and their contents. In the case of fire-proof structures, the extra charges are just one-half those mentioned. The basis rates are established in each community or section of the country by the local rating boards. The states in which the "Analytic System" is used at present are as follows: Colorado, Indiana, Illinois, Iowa, Kansas, Kentucky, Michigan, Missouri, Minnesota, North Dakota, Nebraska, New Mexico, Ohio, Oklahoma, South Dakota, Tennessee, Wyoming, Wisconsin and West Virginia. In some of these states the underwriters are legally required to use it in

The Analytic System

rating all risks. In others, the underwriters have adopted the schedule of their own volition. Throughout the United States the "Analytic System" is recognized as authoritative and carries great weight with all the insurance rating bodies. That it ranks corkboard of the Nonpareil type among the best insulating materials from the underwriters' standpoint, is in itself ample proof of the value of the material as a fire-retardant.

VII. Nonpareil Corkboard is Reasonable in Cost.

Initial Cost Not Excessive

Probably the most common argument advanced in the past against Nonpareil Corkboard has been that its cost is excessive. In recent years, however, improved methods of manufacture, larger factories, and increased output have so decreased the cost of production, that even in initial cost it now compares favorably with any type of competing material. If, in addition, its durability and long life in service are taken into consideration, comparison is out of the question.

Cheap in the Long Run

True economy looks beneath price into quality; it has nothing in common with the "penny wise and pound foolish" policy; it addresses itself to the man who is willing to weigh present figures in the light of future returns. The number of plant owners who have come to look beyond mere first cost, who realize the value of honest insulation properly designed and installed, has been steadily increasing. For such, the following illustration, which shows clearly the dividend paying capacity of Nonpareil Corkboard insulation, will have particular interest:

A Typical Case

Let us assume that there is to be erected in Pittsburgh, Pa., a cold storage room designed to hold a temperature of 6° F., twenty by thirty by ten feet high. The brick walls are to be thirteen inches thick; the ceiling and floor are to consist of six inches of concrete. The mean annual temperature in Pittsburgh, according to the United States Weather Bureau, is approximately 53° F.; hence the average difference between the temperature of this contemplated cold storage room and the outside air would be 47° F. Careful calculation shows that without any insulation whatsoever, the transmission through the bare walls, floor and ceiling would amount to 547,107,000 B. T. U. every year. A British Thermal Unit, i. e., B. T. U., is the amount of heat required to raise the temperature of a pound of water one degree Fahrenheit. 288,000 B. T. U. are equivalent to one ton of refrigeration. Therefore, to offset the heat that would leak into the cold storage room, without insulation, 1900 tons of refrigeration would be required, which, at fifty cents a ton, would cost $950.00 per annum.

Without Insulation

Let us now insulate the room, applying five inches of Nonpareil Corkboard to the walls and ceiling, putting it up in two courses, one of three-inch, and the other of two-inch material, both in Portland cement, joints broken both ways, with a cement plaster finish. On the six-inch concrete base, both courses of corkboard would be laid down in hot asphalt, the upper surface flooded with the same material, and a four-inch concrete working floor placed on top. Calculating the heat leakage now with the insulation, it is found that in a year it would amount to only 41,549,000 B. T. U., to offset which would require but 144 tons of refrigeration, costing fifty cents a ton, $72.00. Subtracting this

With Insulation

amount from the cost of refrigeration which would be required if there were no insulation, the net

The Saving

saving is $878.00 per year. The cost of installing Nonpareil Corkboard, as just specified, in Pittsburgh, Pa., including the cement plaster and concrete working floor, would be approximately $1004. Hence the insulation would actually pay for itself in fourteen months, a return on the original investment of eighty-seven per cent per annum. Best of all, it would continue paying the same dividend every year as long as the building remained standing, since it does not deteriorate in service.

Cheaper materials there are in first cost. Perhaps they will do the work that is expected of them for a time, but sooner or later condensation will get in its deadly work. The insulation will become waterlogged and inefficient, and eventually will have to be torn out and replaced at great expense and inconvenience. The time to insulate properly is when the building is erected.

Service Details

Thickness Depends on Several Factors

The proper thickness of Nonpareil Corkboard to install, in order to maintain a given temperature economically, depends, as with every other type of insulation, upon several factors, which vary in the case of each plant:

(*a*) The character of the building—whether brick, stone, concrete, hollow tile or frame;

(*b*) The thickness of the walls, floors and ceilings;

(*c*) The temperature to be maintained;

(*d*) The climatic conditions;

(*e*) The character of the material to be stored or the purpose for which the rooms are to be used;

(*f*) The cost of producing refrigeration.

Each case that arises must be considered on its own merits. Generally speaking, however, it may be said that under average conditions, the thicknesses of Nonpareil Corkboard that can be economically installed for the several temperatures noted, are as follows: **Thickness to Install**

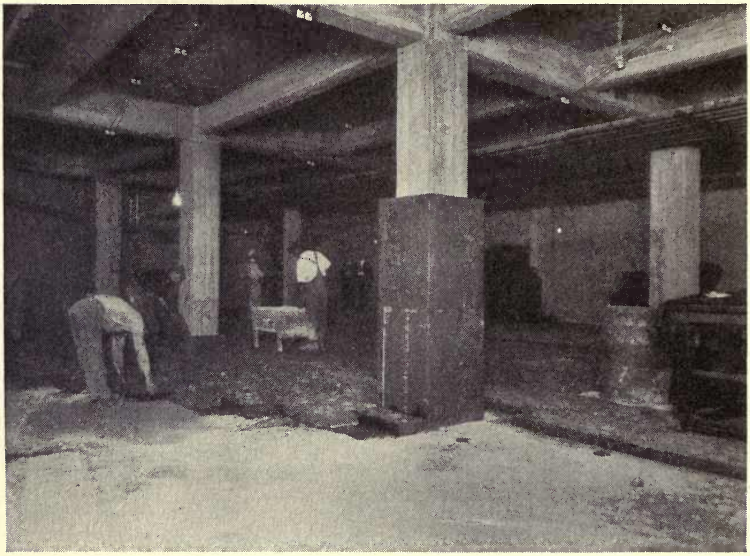
Temperatures	Thickness of Nonpareil Corkboard
—20° to — 5° F.	Eight inches
— 5° to + 5° F.	Six "
5° to 20° F.	Five "
20° to 35° F.	Four "
35° to 45° F.	Three "
45° and above	Two "

For the bottom of freezing tanks, five inches or preferably six inches of Nonpareil Corkboard should be employed; around the sides the same thickness of corkboard, or twelve inches of granulated cork securely tamped in place. **Freezing Tanks**

Structural Suggestions

In designing the insulation for refrigerating plants, there are a number of special points that should be kept in mind if the best results are to be secured:

Solid Construction: In constructing cold storage rooms and buildings, it is always desirable to eliminate hollow spaces in the walls, floors and ceilings to as great an extent as possible. Scientific tests and actual experience have demonstrated that so-called "sealed air-spaces" are in reality, seldom, if ever, air-tight, and that, consequently, they usually serve merely as gathering places for moisture and **Danger of Moisture and Dry Rot** frost. Furthermore, built-up air-spaces are of little practical value for insulating purposes on account of convection—the natural circulation of the air which they contain. In frame structures, concealed air-spaces materially increase the fire hazard and are apt to become harboring places for rats, mice



Installing Nonpareil Corkboard on floor and columns.
Terminal Freezing & Heating Company, Baltimore, Md.

and other vermin. Lumber that is sealed up with no chance for air to circulate about it is, furthermore, subject to dry rot. So, from every point of view, a solid, compact type of insulation is preferable, especially since by using Nonpareil Corkboard, such methods of construction can be employed with no sacrifice of insulating efficiency.

Danger from Condensation

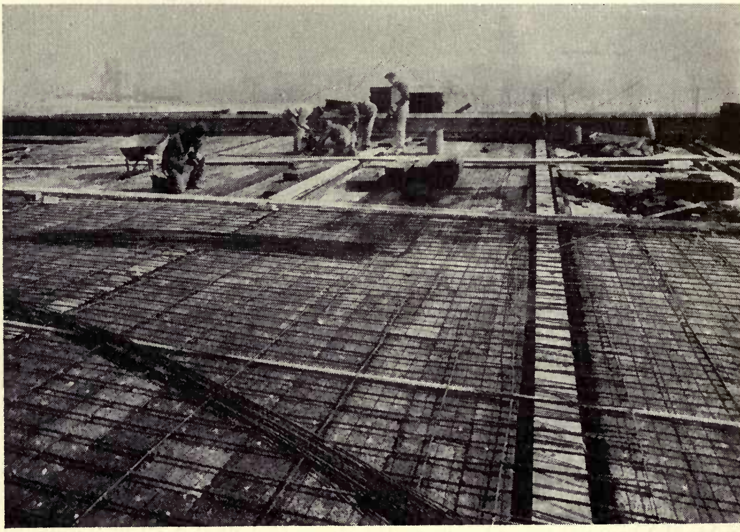
Hollow Tile: As may be inferred from the preceding paragraph, the use of hollow tile in the ceilings and floors of cold storage buildings is always to be deprecated. In more than one instance in recent years, ceilings of hollow tile have caused serious loss through the condensation of moisture in the open spaces in the tile. Under certain conditions, it is almost impossible to prevent such trouble. The safe method is to use concrete roof and ceiling slabs.

Floor Insulation: Many users of refrigeration do not appreciate the importance of adequately insulating the floors of their cold storage rooms, particularly when such rooms are located on the ground. As a matter of fact, the average temperature of the ground is from 50° to 60° F. and the loss of refrigeration that can take place over a large uninsulated floor area is surprising. From the standpoint of operating efficiency it is really just as important to insulate the floor properly, as it is to protect the walls and roof. Where temperatures below the freezing point are carried, failure to insulate the ground floor may entail serious consequences, as instances have been known in which the freezing of the earth beneath the building foundations has thrown the entire building structure out of plumb. On a smaller scale, similar trouble has been encountered where freezing tanks have been set on the ground without adequate insulation. Floors should be protected with insulation equally as heavy as that used on the walls, and sharp freezers should always be located on the upper floors of cold storage buildings, not in the basement.

Great Loss of Refrigeration

Danger from Ground Freezing

Column Insulation: In the light of the preceding paragraph, the importance of insulating concrete and steel columns—particularly in basements and lower floors—of cold storage buildings is self-evident. If such columns are left unprotected in rooms carried below the freezing point, the earth at the base of each column will freeze up in time, with what may prove serious results. For when the earth freezes it expands, causing a gradual upheaval, which may even go so far as to threaten the stability of the building itself. All columns should be insulated

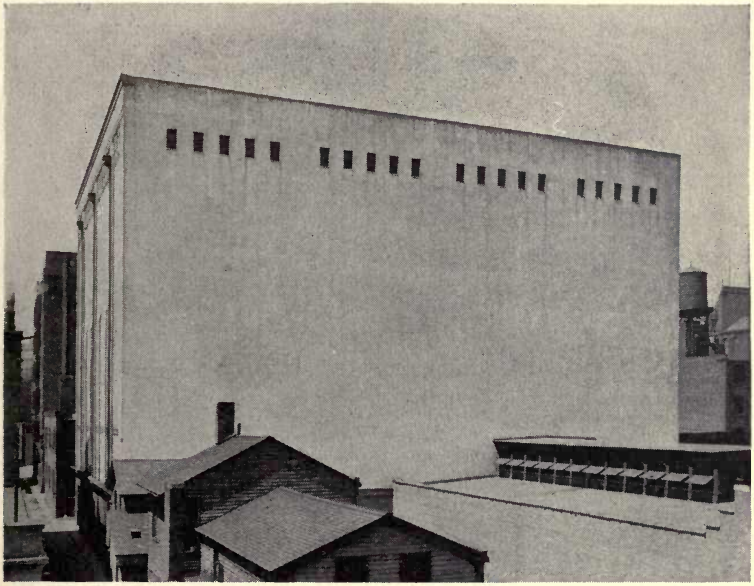


Laying Nonpareil Corkboard in ceiling forms before concrete was poured in. Alpine Ice Company, North Kansas City, Mo.

adequately, and the insulation on the columns should connect with the insulation on the floor.

Corkboard Laid in Forms

Concrete Ceilings: In insulating concrete ceilings, Nonpareil Corkboard is laid up against the ceiling slab in a bed of Portland cement mortar and propped in position until the cement sets. When the insulation is installed, however, at the time the building is erected, a different method is frequently used which is more economical: viz., the sheets of corkboard are laid down in the ceiling forms, which are made correspondingly deeper, and the concrete then poured in on top. After the forms are removed, a Portland cement plaster finish is applied to the exposed surface of the cork, or if two courses of insulation are necessary, the second course is erected against the under surface of the first in either Port-

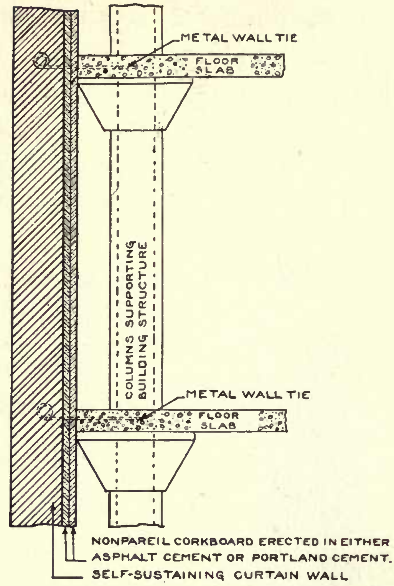


The first cold storage warehouse built with continuous wall insulation from basement to roof line. Sheriff Street Market & Storage Company's warehouse, Cleveland, Ohio—insulated throughout with Nonpareil Corkboard.

land cement mortar or asphalt cement. Specifications Nos. 11, 12 and 13 on pages 95, 96 and 97 cover this method of construction in detail.

No Breaks at Floor Levels

Continuous Insulation: The desirability of making the insulation of the walls of a cold storage building continuous, i. e., without breaks at the floor levels, is obvious. In recent years, this object has been attained in a number of plants by building an interior structure of concrete and steel to carry the load of the building and its contents, and then casing it in with self-sustaining curtain walls, entirely independent of the interior structure, except for a few small metal ties. The insulation, of course, is applied against the inner surface of the curtain walls in a continuous sheet from the basement to the roof line without breaks at the floor levels. As shown in Specifications Nos. 16 and 17 on pages 100 and 101, the wall insulation in such cases is generally carried through the roof slab so as to connect with the roof insulation. In this way the building is literally enveloped with insulation and loss of refrigeration is reduced to a minimum. This method of construction has been utilized in almost all of the large cold storage warehouses erected within the past six years. Further details will be cheerfully supplied on request.

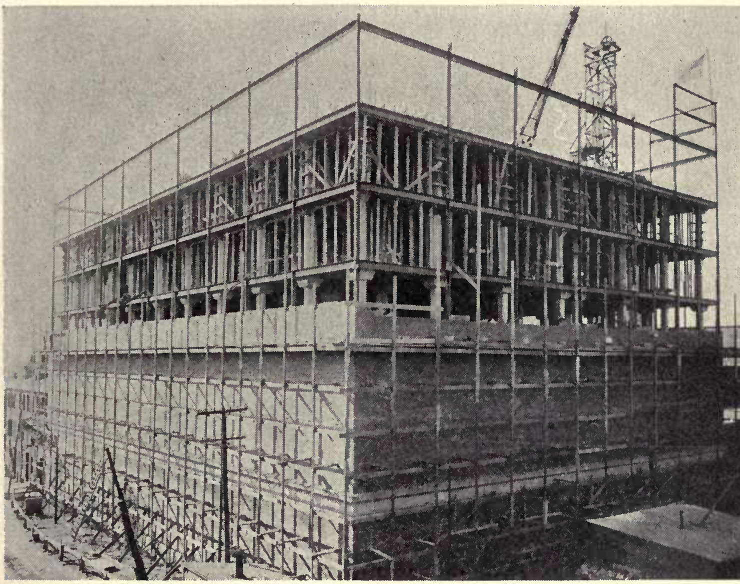


Continuous wall insulation

Save Space and Lumber

Solid Cork Partitions: In cases where there is no load to be carried, so-called "Solid Cork Partitions" consisting of sheets of Nonpareil Corkboard erected edge on edge and securely toe-nailed together, have proved entirely satisfactory. These partitions are built successfully out of a single course or of two courses of corkboard and are surprisingly stable even when constructed to as great a height as 24 feet.

No studding whatever is required except at the door openings. Solid cork partitions not only save space but also the cost of the tile or lumber which would otherwise be required. Complete specifications (Nos. 27, 28 and 29) for the erection of the three types in common use are given on pages 111-114. The heights

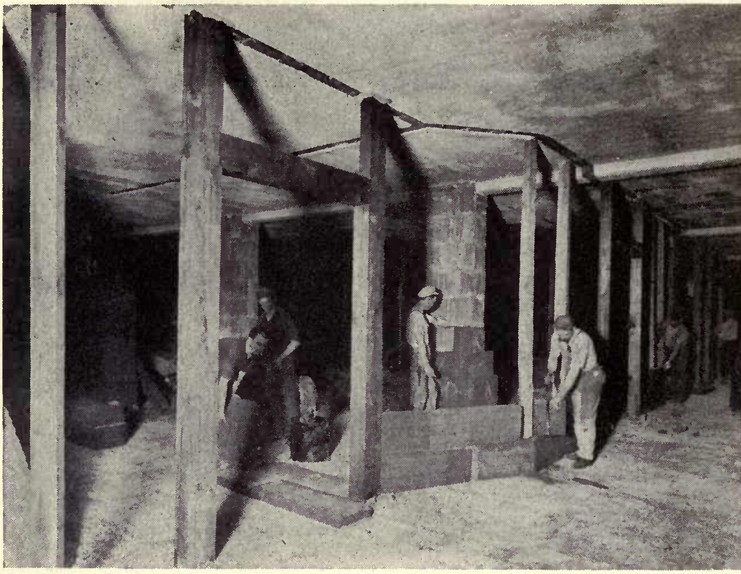


Boston Terminal Refrigerating Company's plant, Boston, Mass., under construction. The interior structure of concrete and the self-sustaining curtain walls can be clearly seen.

recommended for the several thicknesses indicated are as follows: 3 inches thick, 12 feet; 4 inches thick, 16 feet; 5 inches thick, 20 feet; 6 inches thick, 24 feet. Small coolers are frequently constructed with all four sides of solid cork partition work, the ceiling being supported by a simple wooden frame or tee irons. Details of this construction will be supplied on application.

Bunker Lofts: When bunker lofts are used in cold storage rooms, the floors should always be insulated in order to promote the circulation of the air and prevent the condensation of moisture on the under side. While the thickness of Nonpareil Corkboard specified for this work varies, under average conditions satisfactory results will be secured if two-inch sheets are used. The corkboard is usually

Promotes Air Circulation and Prevents Condensation

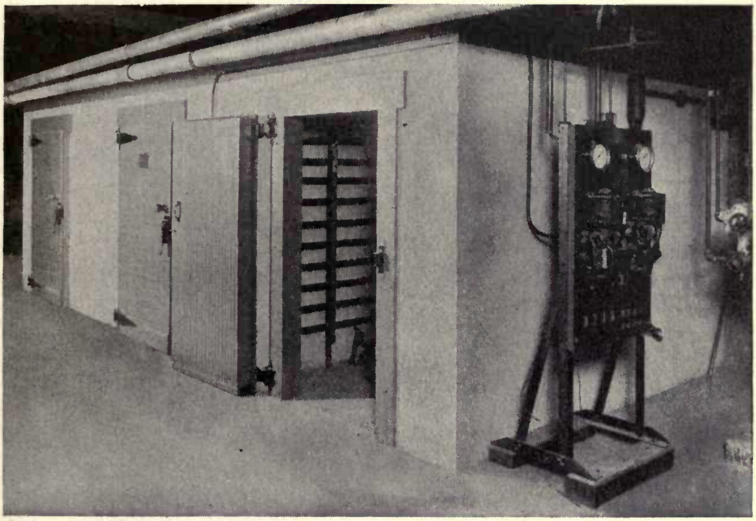


Erecting solid Nonpareil Corkboard partitions at Philadelphia Warehousing & Cold Storage Company's plant, Philadelphia, Pa. Notice the permanent studs and lintels at the door openings.

applied to the upper surface of the bunker floor in hot asphalt, and the surface flooded with the same material. A single layer of ⅞-inch T. & G. boards should then be laid over the asphalt, and the waterproofing or metal pan placed directly on top.

Ironed on Asphalt Mastic Finish: For bunker rooms, coil lofts, ice storage rooms, chill rooms and other refrigerated rooms in which the humidity is high, the use of an asphalt mastic finish, ironed on the surface of the corkboard at the factory, is recommended, instead of Portland cement plaster. The asphalt mastic is approximately one-eighth inch thick, all air-holes being eliminated and the surface left smooth and even by the process used in applying it. It is impossible to secure a satisfactory finish by

For Coil Lofts, Chill Rooms, Ice Storage Rooms, etc.



Small cold storage rooms with all four walls of solid cork partition work. Geo. K. Stevenson & Co., Pittsburgh, Pa.

mopping the asphalt on, after corkboard is erected, since an air- and waterproof coating cannot be obtained in this way, and the surface is always rough and unsightly. With the finish ironed on the surface of the corkboard at the factory, however, these difficulties are entirely overcome. The joints between the sheets are effectually sealed by running the point of a hot trowel along them. Specification No. 34 for this type of finish is given on page 119.

Cork Brick Floors: In cold storage rooms, anterooms and shipping rooms where there is a great deal of trucking, rolling of barrels, handling of heavy tubs, cans, etc., concrete floors crumble and wear out rapidly, requiring frequent replacement. Where conditions of this nature prevail, Cork Brick floors have been found to give excellent satisfaction. Cork Brick are composed of finely granulated cork and refined asphalt heated and thoroughly mixed, then moulded, under pressure into brick form. The brick measure 9 x 4 x 2 inches and are laid flat. Four will cover exactly one square foot of surface. They are thoroughly sanitary, easy under foot, practically noiseless, never slippery—wet or dry, and very easy to install. While the first cost is greater than concrete, the ultimate cost has proved to be less owing to their extraordinary durability. Cork Brick floors have been in use for several years in a number of cold storage warehouses, ice cream plants, creameries, etc. and also in thousands of dairy barns, horse stables, sheep pens, and piggeries, where they are giving universally satisfactory service. Specification No. 36 on page 120 indicates how Cork Brick floors should be installed in refrigerating plants. A special booklet entitled, *"Cork Brick Floors,"* in reference to the use of Cork Brick in cow stalls, horse stalls, etc. will be mailed on request.

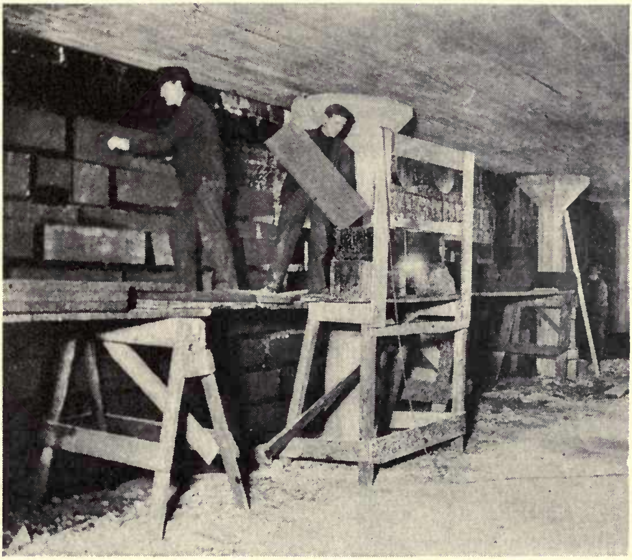
Remarkably Durable in Service

Nails and Skewers: In erecting Nonpareil Corkboard, ordinary wire nails should never be employed, for they soon rust out. Galvanized wire nails should always be used instead. Where corkboard is erected in two layers, the second course can, if desired, be secured to the first with wooden skewers, in place of the galvanized nails. In the judgment of some architects and engineers, the skewers are preferable.

Nails Should Be Galvanized

Odorless Asphalt: Food stuffs are so subject to taint, that as explained on pages 48 and 49, it is essential that nothing be used in connection with the insulation of cold storage rooms, or even in the building structure itself, which has a marked or penetrating odor. For this reason tar or pitch should never be employed in erecting corkboard

Danger of Taint



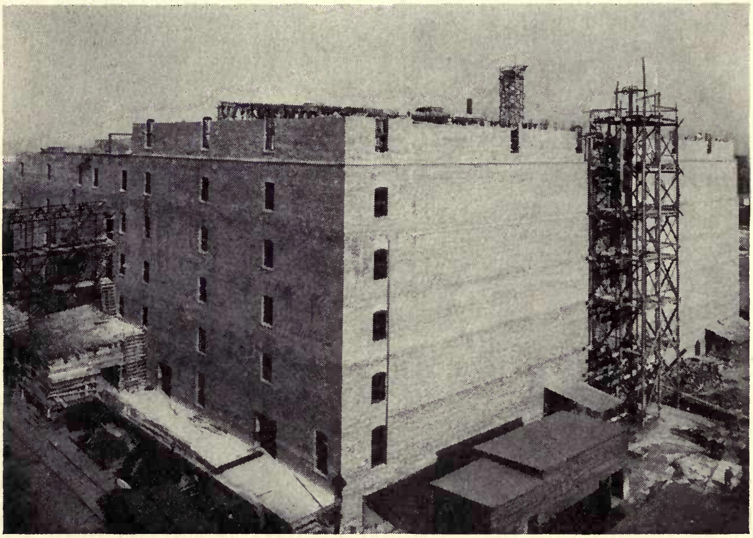
Erecting Nonpareil Corkboard in odorless asphalt cement against tile partition

insulation. Asphalt that is entirely free from odor should always be utilized instead. To secure odorless asphalt of the proper consistency in the open market, is frequently difficult. Hence, an ample stock is always carried by the Armstrong Cork & Insulation Company at its factories at Beaver Falls, Pa., and Camden, N. J., and also in warehouses at convenient points, so that whatever asphalt is needed can be shipped with corkboard orders, if desired.

Construction Department

Contract Work Backed by Guarantee

The Construction Department is in position to submit specifications and estimates for the insulation of any structure, large or small, and with its corps of experienced erecting superintendents, to execute contracts, however large they may be, with promptness and in a thoroughly workmanlike manner. All such contract work is backed by the guarantee of the Armstrong Cork & Insulation Company. Years of experience in this particular field have yielded a mass of practical data, which is at the service of all prospective customers. Through extended experience, the Company's engineers are frequently able to draw up specifications or suggest modifications which result not only in saving in initial cost of construction, but also in more economical operation.



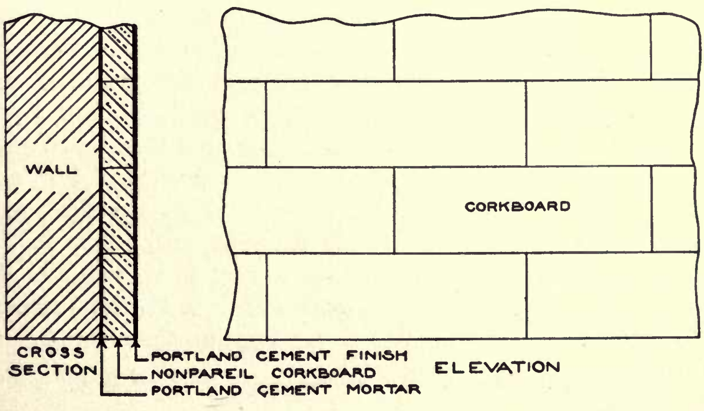
Warehouse of the Morris Cold Storage Company, Chicago, Ill., under construction. This building is 200 feet square, and required 1,500,000 feet, board measure, of Nonpareil Corkboard insulation. This is the largest single insulation contract ever executed and was completed in seventy-seven working days.

Specifications for Erection

The following specifications and accompanying details show those methods of erecting Nonpareil Corkboard which long experience has demonstrated to be the most practical and satisfactory. They cover almost every type of building and with slight modification—changing the thickness of corkboard specified, when necessary—may be used without alteration. The preferred method of construction is given in each specification, possible variations being shown in the appended note.

WALLS

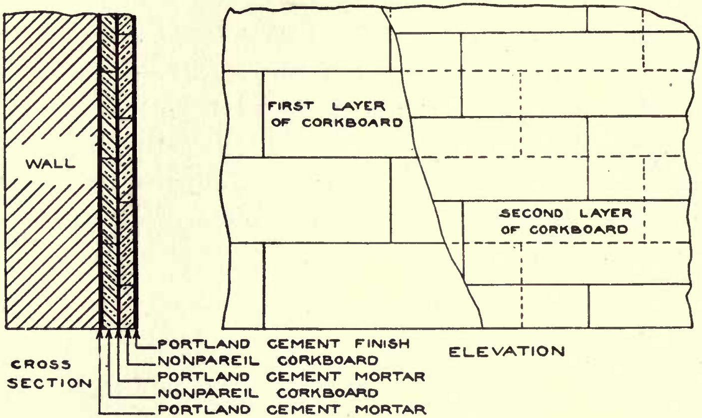
**1. WALLS: Brick, stone or concrete.
Four-inch insulation—single layer, erected with Portland cement.**



Directly against the walls, one layer of 4-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. All vertical joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness erected in one layer.

2. **WALLS: Brick, stone or concrete.**
Four-inch insulation—two layers, both erected with Portland cement.

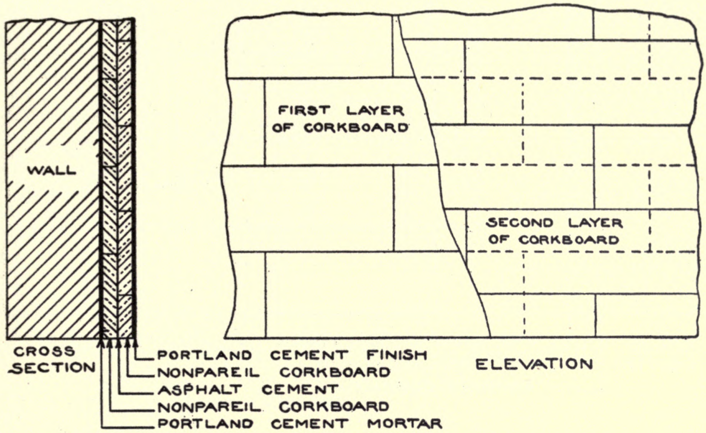


Directly against the walls, one course of 2-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand, all vertical joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be erected against the first in a ½-inch bed of Portland cement mortar, and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness erected in two layers.

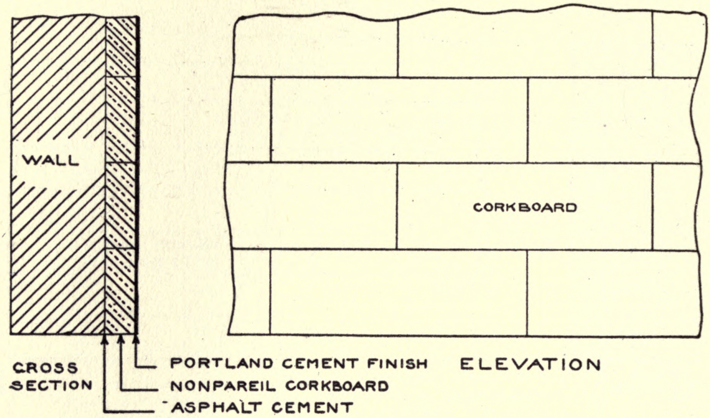
3. WALLS: Brick, stone or concrete.
Four-inch insulation—two layers, the first erected with Portland cement, the second with asphalt cement.



Directly against the walls, one course of 2-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand, all vertical joints being broken. A second course of 2-inch Nonpareil Corkboard shall then be erected against the first in hot asphalt cement and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied, as per Specification No. 33.

Note: The above specification may be used for any thickness erected in two layers.

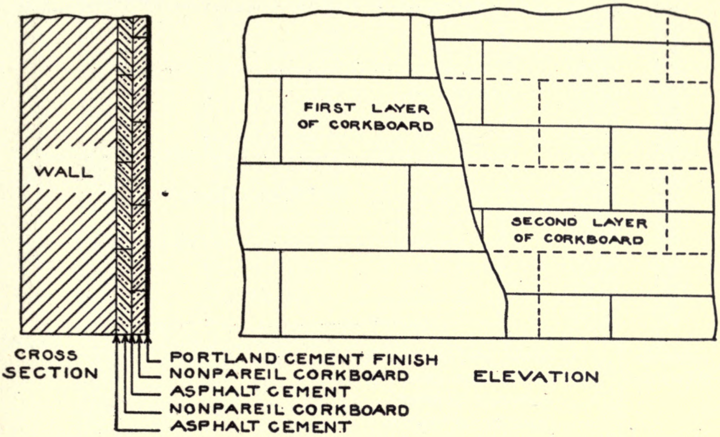
4. WALLS: Brick, stone or concrete. Four-inch insulation—single layer, erected with asphalt cement.



The surface of the walls against which the corkboard is to be applied, shall first be mopped with hot asphalt. One layer of 4-inch Nonpareil Corkboard shall then be erected in hot asphalt cement. All vertical joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied, as per Specification No. 33.

NOTE: The above specification may be used for any thickness erected in one layer.

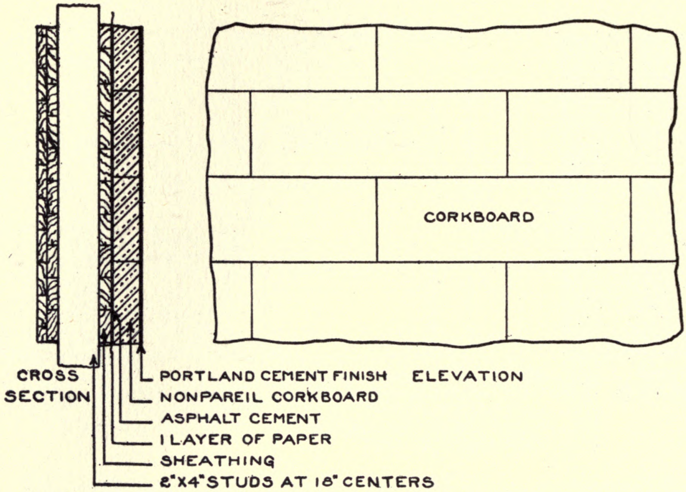
5. WALLS: Brick, stone or concrete.
Four-inch insulation—two layers, both erected with asphalt cement.



The surface of the walls, against which the corkboard is to be applied, shall first be mopped with hot asphalt. One course of 2-inch Nonpareil Corkboard shall then be erected in hot asphalt cement, all vertical joints being broken. A second course of 2-inch Nonpareil Corkboard shall be laid up against the first in hot asphalt cement and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied, as per Specification No. 33.

NOTE: The above specification may be used for any thickness erected in two layers.

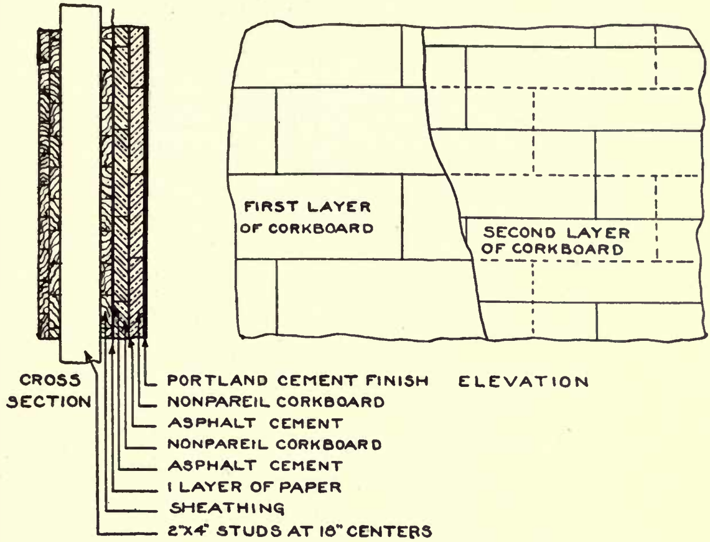
6. WALLS: Frame construction. Four-inch insulation—single layer, erected with asphalt cement.



The wall studding shall be sheathed on the inside with 1⅜-inch T. & G. boards. Against this sheathing one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One course of 4-inch Nonpareil Corkboard shall then be erected against the paper in hot asphalt cement and securely nailed in position with galvanized wire nails. All vertical joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness erected in one layer. If necessary, ⅞-inch sheathing may be used instead of 1⅜-inch, and a second layer of waterproof insulating paper may be substituted for the asphalt cement. The construction specified, however, is the preferable method.

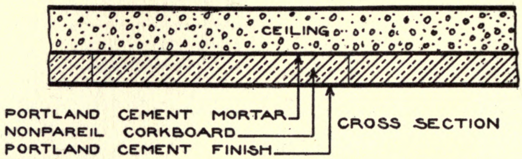
7. WALLS: Frame construction.
Four-inch insulation—two layers, both erected with asphalt cement.



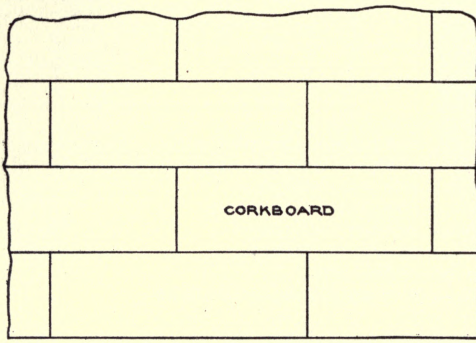
The wall studding shall be sheathed on the inside with 1⅜-inch T. & G. boards. Against this sheathing one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One course of 2-inch Nonpareil Corkboard shall then be erected against the paper in hot asphalt cement and securely nailed in position with galvanized wire nails, all vertical joints being broken. Against the first course, a second course of 2-inch Nonpareil Corkboard shall be erected in hot asphalt cement and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness erected in two layers. If necessary, ⅞-inch sheathing may be used instead of 1⅜-inch and two layers of waterproof insulating paper may be substituted for the asphalt cement. The construction specified, however, is the preferable method.

8. CEILINGS: Concrete.
Four-inch insulation—single layer, erected with Portland cement.



CROSS SECTION

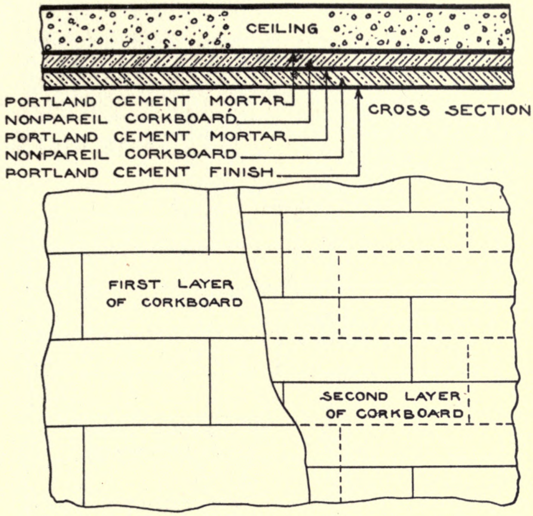


PLAN OF CEILING

Directly against the ceiling one layer of 4-inch Nonpareil Corkboard shall be laid up in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to one part of clean, sharp sand, and propped in position until the cement sets. All transverse joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

Note: The above specification may be used for any thickness erected in one layer.

9. CEILINGS: Concrete.
Four-inch insulation—two layers, both erected with Portland cement.



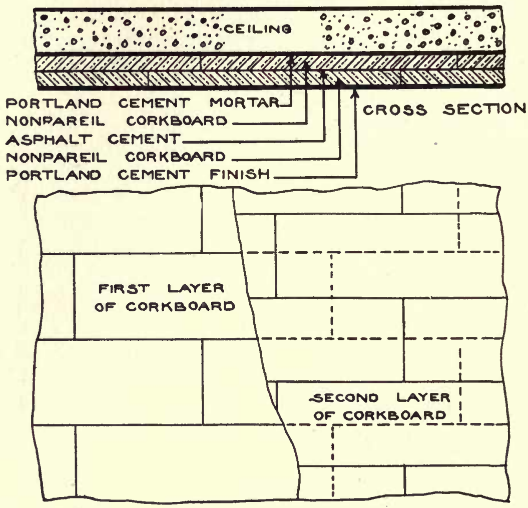
PLAN OF CEILING

Directly against the ceiling, one course of 2-inch Nonpareil Corkboard shall be laid up in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to one part of clean, sharp sand, and propped in position until the cement sets. All transverse joints shall be broken. A second course of 2-inch Nonpareil Corkboard shall then be laid up against the first in a ½-inch bed of Portland cement mortar, and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness erected in two layers.

10. CEILINGS: Concrete.
Four-inch insulation — two layers, the first erected with Portland cement, the second with asphalt cement.

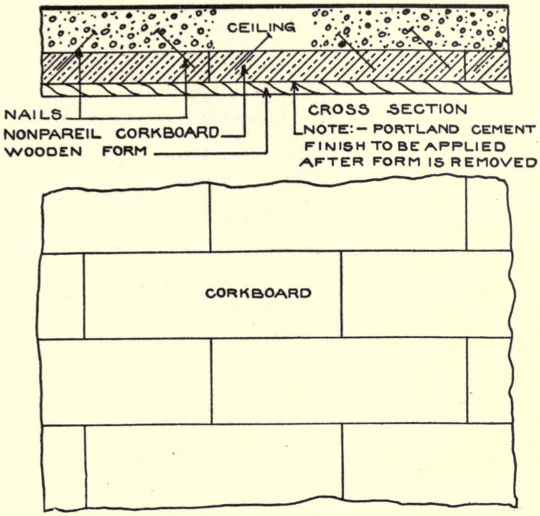


PLAN OF CEILING

Directly against the ceiling, one course of 2-inch Nonpareil Corkboard shall be laid up in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to one part of clean, sharp sand, and propped in position until the cement sets. All transverse joints shall be broken. A second course of 2-inch Nonpareil Corkboard shall then be laid up against the first in hot asphalt cement and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness erected in two layers.

11. CEILINGS: Concrete.
Four-inch insulation—single layer, laid down in ceiling forms before concrete is poured in.



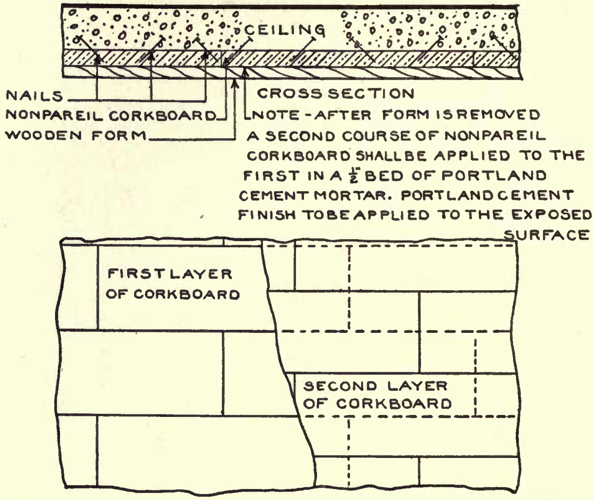
PLAN OF CEILING

The concrete contractor shall construct the wooden forms for the ceiling four inches deeper than would otherwise be necessary. In the concrete forms shall be laid down one course of 4-inch Nonpareil Corkboard. All transverse joints shall be broken. All joints shall be made tight. Long galvanized wire nails shall be driven obliquely into the corkboard—two to the square foot—the heads to be left protruding 1½ inches. The forms shall then be filled in with concrete by the concrete contractor. After the forms are removed, a Portland cement plaster finish shall be applied to the exposed surface of the corkboard, as per Specification No. 33.

NOTE: The above specification may be used for any thickness laid down in one layer, the depth of the forms to be varied accordingly. The nails provide a good key for the concrete. (See pages 76-77.)

12. CEILINGS: Concrete.

Four-inch insulation — two layers, one laid down in the ceiling forms, the second applied to the first with Portland cement.



PLAN OF CEILING

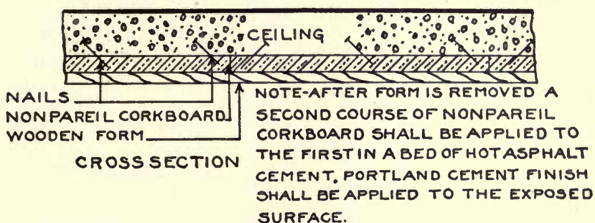
The concrete contractor shall construct the wooden forms for the ceiling two inches deeper than would otherwise be necessary. In the concrete forms shall be laid down one course of 2-inch Nonpareil Corkboard, all transverse joints being broken. Galvanized wire nails shall be driven obliquely into the corkboard—two to the square foot—the heads to be left protruding 1½ inches. The forms shall then be filled in with concrete by the concrete contractor. After the forms are removed, a second course of 2-inch Nonpareil Corkboard shall be laid up against the first in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. The second course of cork-board shall be additionally secured to the first by means of galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

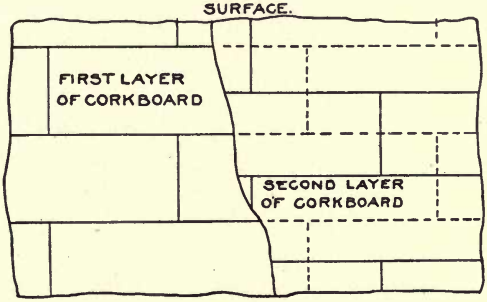
This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in two layers, the depth of the forms to be varied accordingly The nails provide a good key for the concrete. (See pages 76-77.)

13. CEILINGS: Concrete.

Four-inch insulation—two layers, one laid down in the ceiling forms, the second applied to the first with asphalt cement.



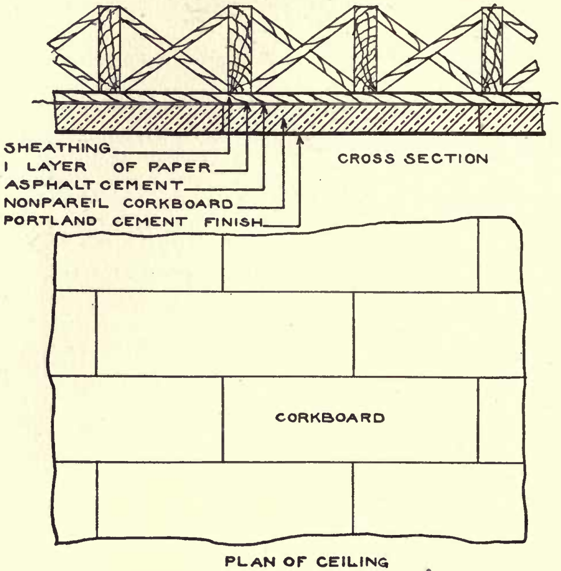


PLAN OF CEILING

The concrete contractor shall construct the wooden forms for the ceiling two inches deeper than would otherwise be necessary. In the concrete forms shall be laid down one course of 2-inch Nonpareil Corkboard, all transverse joints being broken. Galvanized wire nails shall be driven obliquely into the corkboard—two to the square foot—the heads to be left protruding 1½ inches. The forms shall then be filled in with concrete by the concrete contractor. After the forms are removed, a second course of 2-inch Nonpareil Corkboard shall then be laid up against the first in hot asphalt cement and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness laid down in two layers, the depth of the forms to be varied accordingly. The nails provide a good key for the concrete. (See pages 76-77.)

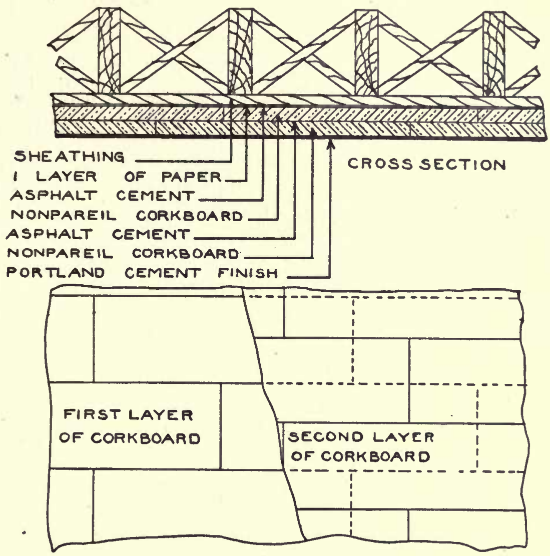
14. CEILINGS: Frame construction. Four-inch insulation—single layer, erected with asphalt cement.



The joists shall be sheathed on the under side with 1⅜-inch T. & G. boards. Against this sheathing one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One layer of 4-inch Nonpareil Corkboard shall then be laid up against the paper in hot asphalt cement and securely nailed in place with galvanized wire nails. All transverse joints shall be broken. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness laid up in one layer. If necessary, ⅞-inch sheathing may be used instead of 1⅜-inch and a second layer of waterproof insulating paper may be substituted for the asphalt cement. The construction specified, however, is the preferable method.

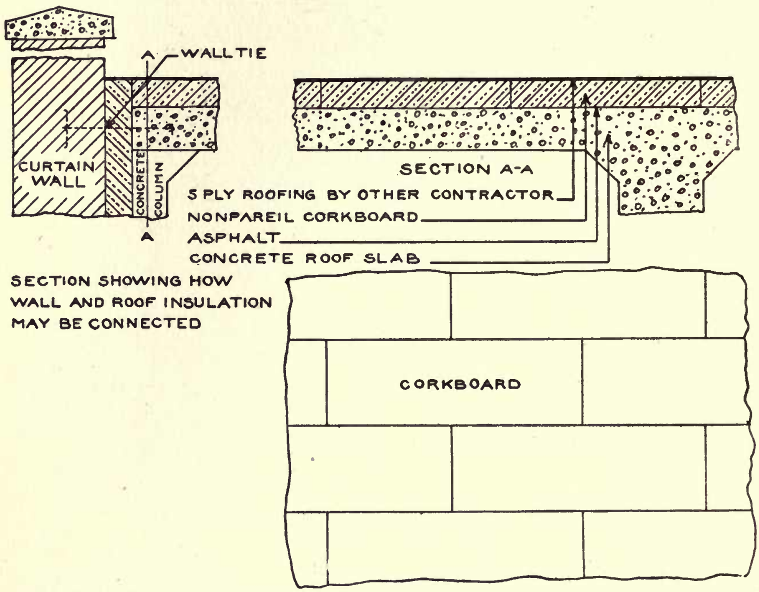
15. CEILINGS: Frame construction. Four-inch insulation—two layers, both erected with asphalt cement.



The joists shall be sheathed on the under side with 1⅜-inch T. & G. boards. Against this sheathing, one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One course of 2-inch Nonpareil Corkboard shall then be laid up against the paper in hot asphalt cement and securely nailed in position with galvanized wire nails, all transverse joints being broken. Against the first course, a second course of 2-inch Nonpareil Corkboard shall be erected in hot asphalt cement and additionally secured to the first with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. A Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: The above specification may be used for any thickness laid up in two layers. If necessary, ⅞-inch sheathing may be used instead of 1⅜-inch and two layers of waterproof insulating paper may be substituted for the asphalt cement. The construction specified, however, is the preferable method.

16. ROOFS: Concrete.
Four-inch insulation—single layer, laid in asphalt.



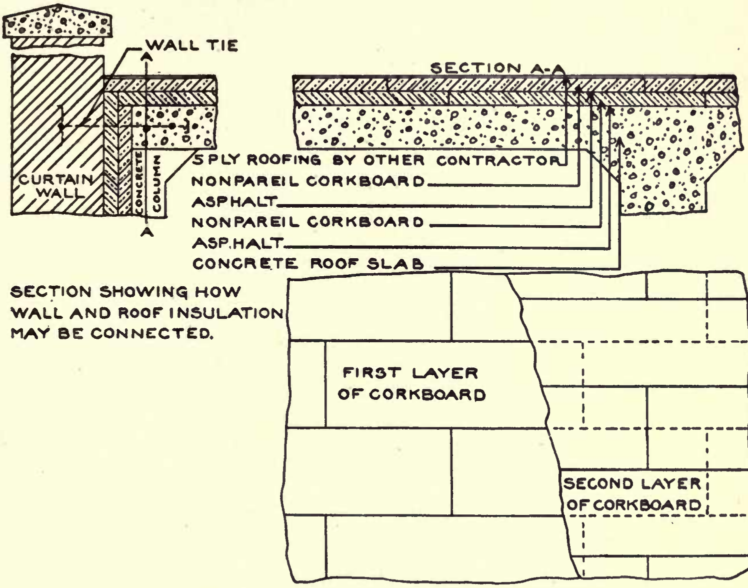
PLAN OF ROOF

On the concrete roof slab which is to be installed and left reasonably smooth and level by the concrete contractor, one course of 4-inch Nonpareil Corkboard shall be laid down in hot asphalt. All transverse joints shall be broken. All joints shall be made tight. * A five-ply felt roofing shall be applied on top of the corkboard by the roofing contractor.

NOTE: The above specification may be used for any thickness laid down in one layer. If the building is of the so-called "curtain-wall" type, viz., with self-sustaining outside walls independent of the interior structure which carries the load of the building and contents, the wall insulation should be carried up as shown in the drawing so as to connect with the roof insulation. (See page 77.) In such cases, the following sentence should be inserted in the above specification at the point marked with an asterisk (*):

"The roof insulation shall connect with the wall insulation, the joint being sealed with hot asphalt."

17. ROOFS: Concrete.
Four-inch insulation—two layers, both laid in asphalt.



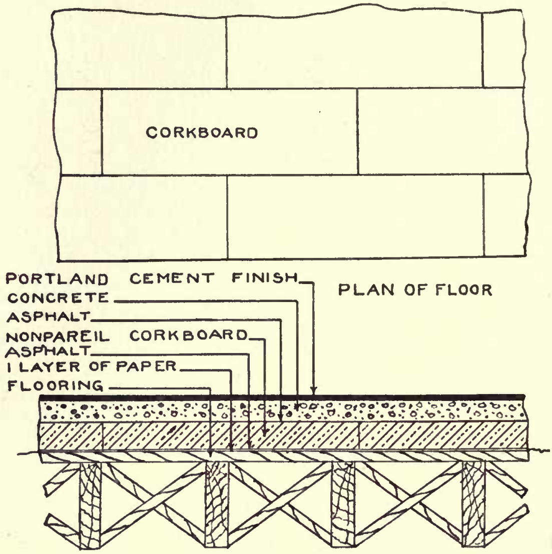
PLAN OF ROOF

On the concrete roof slab which is to be installed and left reasonably smooth and level by the concrete contractor, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All transverse joints shall be broken. On the first course, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. * A five-ply felt roofing shall be applied on top of the corkboard by the roofing contractor.

NOTE: The above specification may be used for any thickness laid down in two layers. If the building is of the so-called "curtain-wall" type, viz., with self-sustaining outside walls independent of the interior structure which carries the load of the building and contents, the wall insulation should be carried up as shown in the drawing so as to connect with the roof insulation. (See page 77.) In such cases, the following sentence should be inserted in the above specification at the point marked with an asterisk (*):

"The roof insulation shall be carried out over the top of the wall insulation, the joints to be staggered and sealed with hot asphalt."

**18. FLOORS: Frame construction.
Four-inch insulation—single layer, laid in asphalt, concrete finish.**

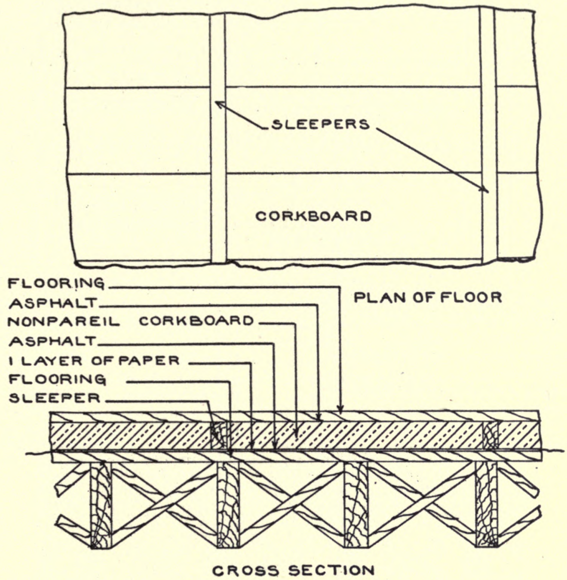


CROSS SECTION

On the wood flooring, which shall consist of T. & G. boards not less than 1⅜ inches thick, one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One course of 4-inch Nonpareil Corkboard shall then be laid down on top of the paper in hot asphalt, all transverse joints being broken. All joints shall be made tight. The upper surface of the corkboard shall be flooded with hot asphalt approximately ⅛ inch thick, and a 4-inch working concrete floor laid down directly on top, as per Specification No. 35.

NOTE: The above specification may be used for any thickness laid down in one layer. For rooms where there is much trucking, a Cork Brick floor is recommended as per Specification No. 36.

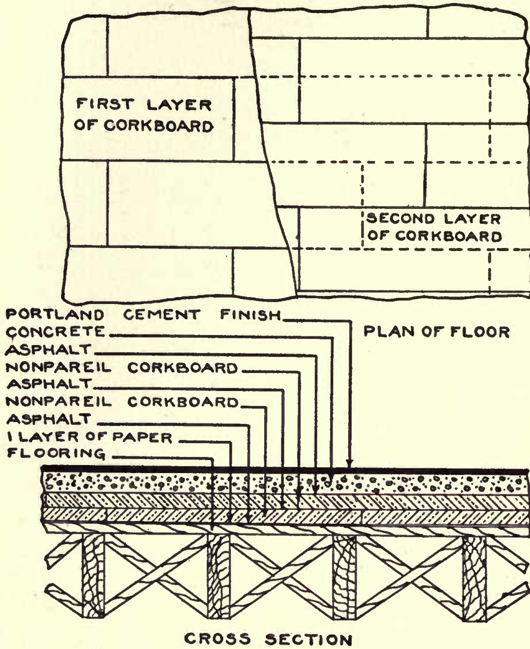
19. FLOORS: Frame construction.
Four-inch insulation—single layer, laid in asphalt, wood finish.



On the wood flooring, which shall consist of T. & G. boards not less than 1⅜ inches thick, one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. 2-inch x 4-inch sleepers shall then be put down on edge on 38-inch centers, and between them one course of 4-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints shall be made tight. The upper surface shall be flooded with hot asphalt approximately ⅛ inch thick. T. & G. flooring shall then be securely nailed down to the sleepers.

NOTE: The above specification may be used for any thickness laid down in one layer, the size of the sleepers to be varied accordingly.

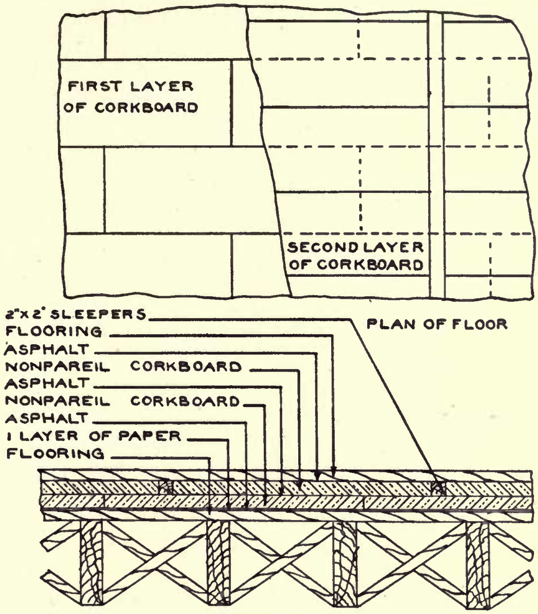
20. FLOORS: Frame construction. Four-inch insulation—two layers, laid in asphalt, concrete finish.



On the wood flooring, which shall consist of T. & G. boards not less than 1⅜ inches thick, one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One course of 2-inch Nonpareil Corkboard shall then be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt approximately ⅛ inch thick, and a 4-inch working concrete floor laid down directly on top, as per Specification No. 35.

NOTE: The above specification may be used for any thickness laid down in two layers. For rooms where there is much trucking, a Cork Brick floor is recommended as per Specification No. 36.

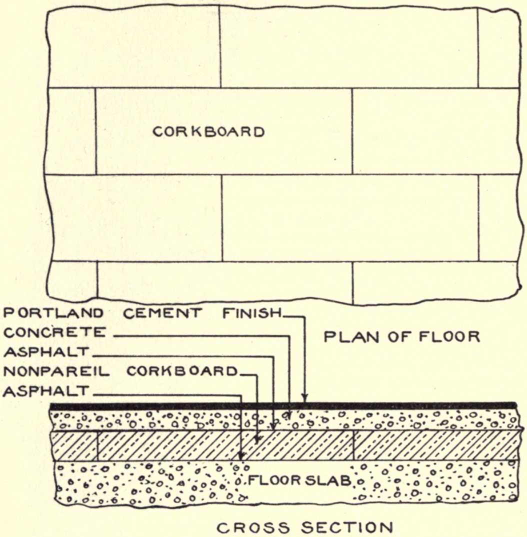
21. FLOORS: Frame construction. Four-inch insulation—two layers, laid in asphalt, wood finish.



On the wood flooring, which shall consist of T. & G. boards not less than 1⅜ inches thick, one layer of waterproof insulating paper shall be applied, all edges lapped at least three inches. One course of 2-inch Nonpareil Corkboard shall then be laid down in hot asphalt, all transverse joints being broken. 2-inch x 2-inch sleepers shall then be put down on 38-inch centers. Between the sleepers, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛ inch thick. T. & G. flooring shall then be securely nailed down to the sleepers.

NOTE: The above specification may be used for any thickness laid down in two layers. The size of the sleepers must be adjusted to the thickness of the second course of corkboard.

22. FLOORS: Concrete.
Four-inch insulation—single layer, laid in asphalt, concrete finish.

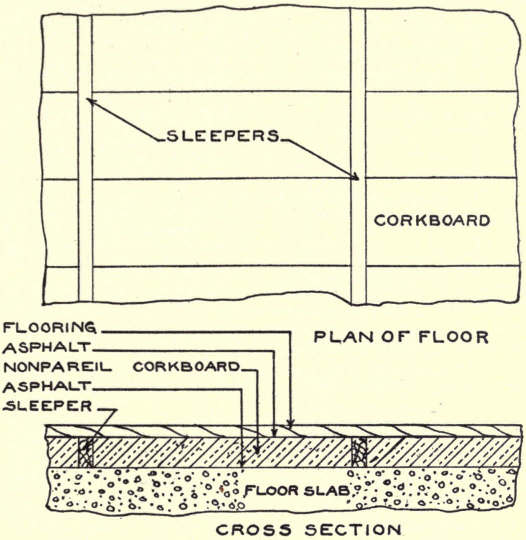


On a reasonably smooth and level concrete base, one course of 4-inch Nonpareil Corkboard shall be laid down in hot asphalt. All transverse joints shall be broken. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately 1/8 inch thick, and a 4-inch working concrete floor laid down directly on top, as per Specification No. 35.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in one layer. For rooms where there is much trucking, a Cork Brick floor is recommended as per Specification No. 36.

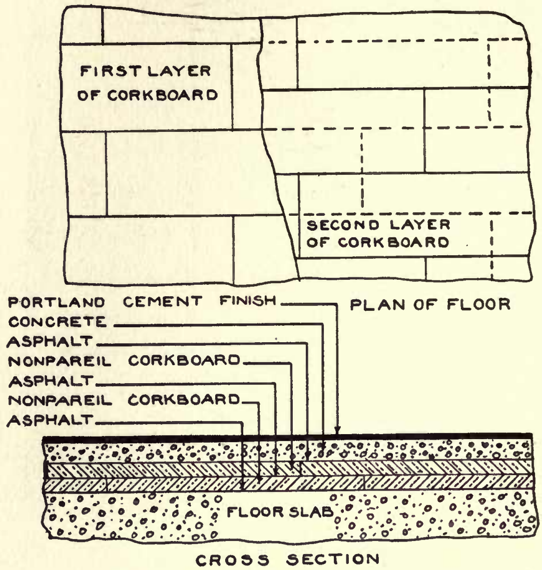
23. FLOORS: Concrete.
Four-inch insulation—single layer, laid in asphalt, wood finish.



On a reasonably smooth and level concrete base, 2-inch x 4-inch sleepers shall be laid down on edge on 38-inch centers. Between the sleepers, one course of 4-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately 1/8 inch thick. T. & G. flooring shall then be securely nailed down to the sleepers.

NOTE: The above specification may be used for any thickness laid down in one layer, the size of the sleepers to be varied accordingly.

24. FLOORS: Concrete.
Four-inch insulation—two layers, concrete finish.

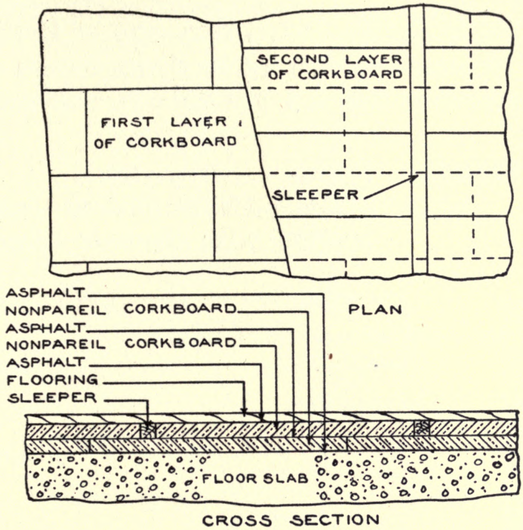


On a reasonably smooth and level concrete base, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately ⅛ inch thick, and a 4-inch working concrete floor laid down directly on top, as per Specification No. 35.

This type of construction is approved by the National Board of Fire Underwriters.

NOTE: The above specification may be used for any thickness laid down in two layers. For rooms where there is much trucking, a Cork Brick floor is recommended as per Specification No. 36.

25. FLOORS: Concrete.
Four-inch insulation—two layers, laid in asphalt, wood finish.



On a reasonably smooth and level concrete base, one course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. 2-inch x 2-inch sleepers shall then be put down on 38-inch centers. Between the sleepers, a second course of 2-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface shall be flooded with hot asphalt, approximately 1/8 inch thick. T. & G. flooring shall then be securely nailed down to the sleepers.

NOTE: The above specification may be used for any thickness laid down in two layers. The size of the sleepers must be adjusted to the thickness of the second course of corkboard.

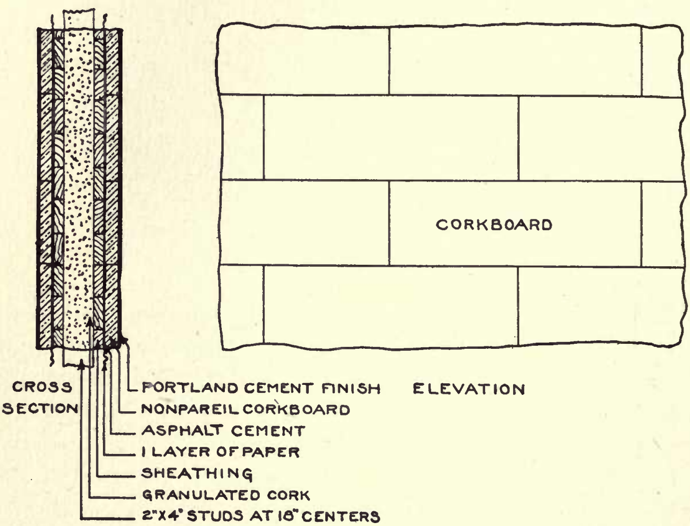
PARTITIONS

There are so many types of partitions that it is possible here only to present those forms that are most frequently met with.

PARTITIONS: Brick, Stone, Concrete or Hollow Tile.

Brick, stone, concrete or hollow partitions are insulated as per Specifications Nos. 1, 2, 3, 4 and 5 for wall work.

**26. PARTITIONS: Frame constructions.
Three-inch insulation—two layers, erected with asphalt cement.**



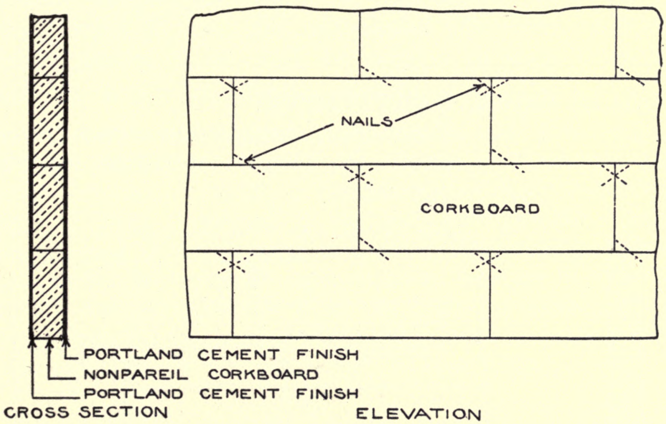
2-inch and 4-inch studding shall be erected on 18-inch centers and sheathed on both sides with 1⅜-inch T. & G. boards. Against the sheathing on both sides of the partition shall be applied one layer of waterproof insulating paper, all edges lapped three inches. One course of 1½-inch Nonpareil Corkboard shall then be erected against the paper in hot asphalt cement on both sides of the partition and securely nailed to the sheathing with galvanized wire nails. All vertical joints shall be broken. All joints shall be made tight. The space between the studs shall be filled with granulated cork well tamped in place. A Portland cement plaster finish shall be applied to both sides of the partition as per Specification No. 33.

NOTE: The thickness of the corkboard should be varied according to the temperature to be maintained. Frequently it is desirable to apply corkboard to only one side of the studding, finishing the other side with matched boards or expanded metal lath and plaster, as preferred.

SOLID CORK PARTITIONS

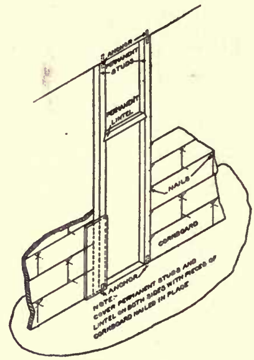
See pages 78 and 79.

27. SOLID CORK PARTITIONS:
Four-inch insulation—single layer.



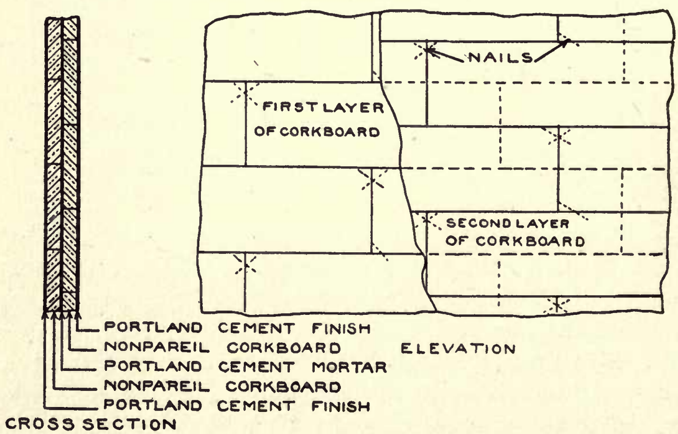
The partition shall be a solid cork partition, consisting of one layer of 4-inch Nonpareil Corkboard built up edge on edge. All joints shall be sealed with hot asphalt cement and made tight. All vertical joints shall be broken. Each corkboard shall be securely toe-nailed to the abutting corkboards and, where possible, to the walls, floor and ceiling, with long special galvanized wire nails or wooden skewers. Where doors are to be set, 4-inch x 4-inch permanent studs with a lintel between them shall be erected in the line of the partition so as to form an opening the size of the door frame, and securely anchored to the floor and ceiling. After the partition is erected, these permanent studs and lintels shall be covered on both sides with 2-inch Nonpareil Corkboard nailed in place with galvanized wire nails. A Portland cement plaster finish shall be applied to both sides of the partition as per Specification No. 33.

NOTE: The above specification may be used also for three-inch solid cork partitions consisting of a single course of 3-inch Nonpareil Corkboard, and for six-inch solid cork partitions consisting of a single course of 6-inch Nonpareil Corkboard, the size of the permanent studs and lintels at the door openings to be adjusted accordingly. The drawing at the right indicates how the permanent studs at the door openings are installed.



28. SOLID CORK PARTITIONS:

Four-inch insulation—two layers, with Portland cement mortar between.



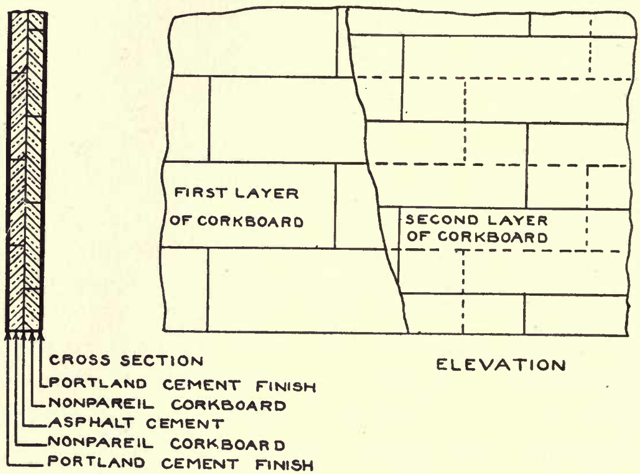
The partition shall be a solid cork partition, erected as follows: One layer of 2-inch Nonpareil Corkboard shall be built up edge on edge. All joints shall be sealed with hot asphalt cement and made tight. All vertical joints shall be broken, and each corkboard securely toe-nailed to the abutting corkboards and, where possible, to the walls, floor and ceiling, with long special galvanized wire nails or wooden skewers. Against this first layer, a second layer of 2-inch Nonpareil Corkboard shall be erected in a ½-inch bed of Portland cement mortar, (mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand), and additionally secured to the first layer with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. Where doors are to be set, permanent studs 4½ inches thick and 4 inches wide with a lintel between them shall be erected in the line of the partition so as to form an opening the size of the door frame, and securely anchored to the floor and ceiling. After the partition is erected, these permanent studs and lintels shall be covered on both sides with 2-inch Nonpareil Corkboard nailed in place with galvanized wire nails. A Portland cement plaster finish shall be applied to both sides of the partition as per Specification No. 33.

NOTE: The above specification may be used also for five-inch solid cork partitions, consisting of one course of 2-inch and a second course of 3-inch corkboard; or for six-inch partitions, consisting of 2 layers of 3-inch corkboard; or for eight-inch partitions consisting of two layers of 4-inch corkboard, etc. The permanent studs and lintels at the door openings must, in every case, be ½ inch thicker than the combined thickness of the two courses of corkboard of which the partition is composed. See drawing referred to in the note under Specification No. 27 for arrangement of such studs.

29. SOLID CORK PARTITIONS:

Four-inch insulation—two layers, with asphalt cement between.

The partition shall be a solid cork partition, erected as follows: One layer of 2-inch Nonpareil Corkboard shall be built up edge on edge. All joints shall be sealed with hot asphalt cement and made tight. All vertical joints shall be broken, and each corkboard securely toe-nailed to the abutting corkboards and, where possible, to the walls, floor and ceiling, with long special galvanized wire nails or wooden skewers. Against this first layer, a second layer of 2-inch Nonpareil Corkboard shall be erected in hot asphalt cement and additionally secured to the first layer with galvanized wire nails or wooden skewers. All joints in the second course shall be broken with respect to all joints in the first course. All joints

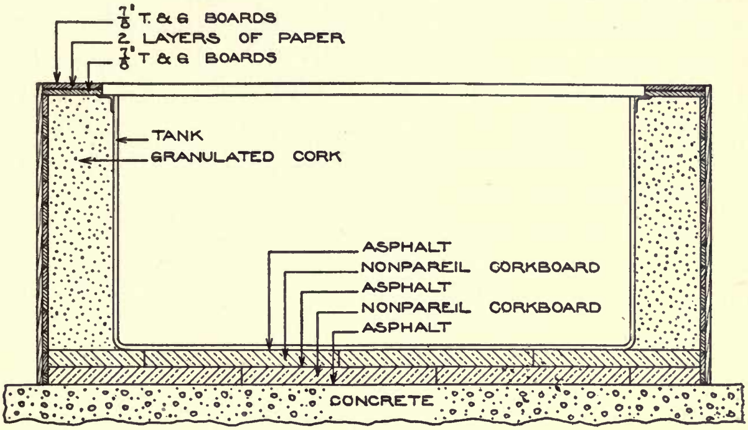


shall be made tight. Where doors are to be set, 4-inch x 4-inch permanent studs with a lintel between them shall be erected in the line of the partition so as to form an opening the size of the door frame, and securely anchored to the floor and ceiling. After the partition is erected, these permanent studs and lintels shall be covered on both sides with 2-inch Nonpareil Corkboard nailed in place with galvanized wire nails. A Portland cement plaster finish shall be applied to both sides of the partition as per Specification No. 33.

NOTE: The above specification may be used for five-inch solid cork partitions, consisting of one course of 2-inch and a second course of 3-inch Nonpareil Corkboard; or for six-inch partitions, consisting of two layers of 3-inch Nonpareil Corkboard; or for eight-inch partitions, consisting of two layers of 4-inch Nonpareil Corkboard, etc. The thickness of the permanent studs and lintels at the door openings must, in every case, equal the combined thickness of the two courses of corkboard of which the partition is composed. See drawing referred to in the note under Specification No. 27 for arrangement of such studs.

30. FREEZING TANKS:

Six inches Nonpareil Corkboard underneath.
Twelve inches Granulated Cork on sides.



CROSS SECTION OF TANK

BOTTOM: On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface of the corkboard shall then be flooded with hot asphalt, approximately ⅛ inch thick, and left ready for the tank to be set down directly on top. The insulation shall extend at least 12 inches beyond the sides of the tank.

NOTE: Experience has shown that heavy insulation on the bottom of freezing tanks will materially increase their output. Although some engineers specify only two layers of 2-inch Nonpareil Corkboard for this purpose, 5 inches, i. e., one layer of 2-inch and another of 3-inch; or preferably six inches, as above specified, should always be used.

SIDES: Retaining walls of lumber shall be constructed so as to leave a space of 12 inches all around the four sides of the tank as follows: Erect 2 x 12-inch studs on 30-inch centers all around the tank at right angles to the tank's sides. These studs shall then be sheathed on the outside with one course of ⅞-inch T. & G. boards securely nailed in place. Against the sheathing, two layers of waterproof insulating paper shall be applied, all edges lapped at least three inches. The paper shall then be covered with a second layer of ⅞-inch T. & G. boards nailed in place. The space between the walls and the tank shall be filled with granulated cork well tamped in place. A curbing consisting of two courses of ⅞-inch T. & G. boards with waterproof insulating paper between shall then be installed so as to cover the space filled with granulated cork.

NOTE: Experience has shown that 12 inches of granulated cork is the proper thickness to employ in order to secure the most satisfactory results. If circumstances render it necessary, this may be reduced to 10 inches without serious harm. If the retaining walls surrounding the tanks are of brick or concrete, they should be waterproofed with hot asphalt on the inner surface.

31. FREEZING TANKS:

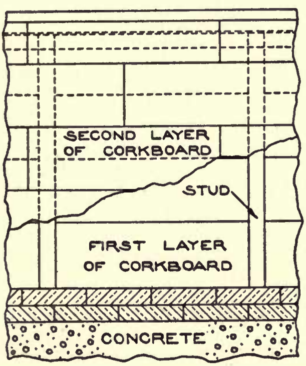
Six inches Nonpareil Corkboard underneath.
Six inches Nonpareil Corkboard on sides.

BOTTOM: On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface of the corkboard shall then be flooded with hot asphalt, approximately ⅛ inch thick, and left ready for the tank to be set down directly on top. The insulation shall extend at least six inches beyond the sides of the tank.

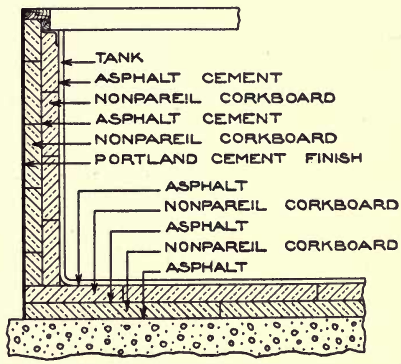
NOTE: See note under Specification No. 30.

SIDES: Against the sides of the tank, 3-inch x 3-inch studs shall be set on 39-inch centers, the upper end of each stud being securely wedged in place. 3-inch Nonpareil Corkboard shall then be laid up between the studs against the side of the tank in hot asphalt cement and securely toe-nailed to the studding with galvanized wire nails. Against the first course, a second course of 3-inch Nonpareil Corkboard shall be erected in hot asphalt cement and securely nailed to the studding, and also to the first course of corkboard. All joints in the second course shall be broken with respect to all joints

SECTIONAL PLAN



ELEVATION



CROSS SECTION

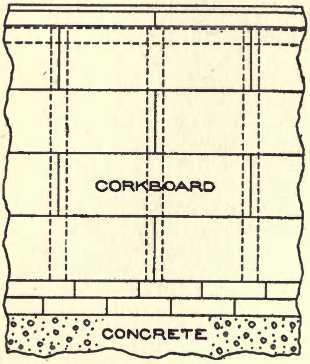
in the first course. All joints shall be made tight. Against the exposed surface of the corkboard, a Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: Not less than six inches of Nonpareil Corkboard should be used in insulating the sides of freezing tanks, but if peculiar circumstances render it necessary to reduce the insulation to 5 inches, 2-inch x 4-inch studs should be erected flat against the sides of the tank on 40-inch centers. 2-inch corkboard should then be applied, followed by one course of 3-inch material. The combination of sheet and granulated cork, as per Specification No. 32, is to be highly recommended. If desired, a matched lumber finish may be applied instead of Portland cement plaster as specified.

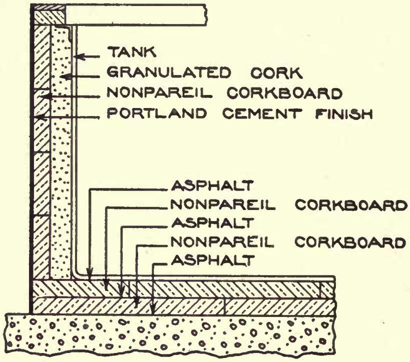
32. FREEZING TANKS:

Six inches Nonpareil Corkboard underneath. Four inches of Granulated Cork and three inches of Nonpareil Corkboard on sides.

SECTIONAL PLAN



ELEVATION



CROSS SECTION

BOTTOM: On a reasonably smooth and level concrete base, one course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt, all transverse joints being broken. On the first course, a second course of 3-inch Nonpareil Corkboard shall be laid down in hot asphalt. All joints in the second course shall be broken with respect to all joints in the first course. All joints shall be made tight. The upper surface of the corkboard shall then be flooded with hot asphalt, approximately 1/8 inch thick, and left ready for the tank to be set down directly on top. The insulation shall extend at least seven inches beyond the sides of the tank.

NOTE: See note under Specification No. 30.

SIDES: Against the sides of the tank, 3-inch x 4-inch studs shall be set on edge on 18-inch centers, the upper ends being securely wedged in place. Against the studs, one course of 3-inch Nonpareil Corkboard shall be securely nailed. All vertical joints shall be broken. All joints shall be sealed with hot asphalt cement. The space between the studs, the sides of the tank, and the corkboard, shall be filled with granulated cork, well tamped in place. On the exposed surface of the corkboard, a Portland cement plaster finish shall be applied as per Specification No. 33.

NOTE: If desired, a matched lumber finish may be applied instead of the Portland cement plaster specified.

33. PORTLAND CEMENT PLASTER FINISH:
Applied to corkboard insulation.

Against the exposed surface of the corkboard, a Portland cement plaster finish approximately ½ inch in thickness shall be applied in two coats. The first shall be approximately ¼ inch in thickness, rough scratched, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. After this coat has thoroughly set, a second coat—mixed in the same proportion—shall be applied approximately ¼ inch in thickness and brought to a float finish. The surface shall be marked off in squares.

NOTE: Portland cement plaster contracts in setting and hence is bound to crack to a certain extent, but this does not affect the efficiency of the insulation in the slightest. When the surface is marked off in squares as provided in this specification, whatever cracking there is, takes place in the score marks and hence is not noticeable.

34. IRONED ON ASPHALT MASTIC FINISH:
For bunker rooms, coil lofts, ice storage rooms, chill rooms, etc. (See page 80.)

The exposed surface of the corkboard shall be protected by an asphalt mastic finish, approximately ⅛ inch thick, ironed on at the factory. After the corkboard is erected, all joints shall be gone over with the point of a trowel hot enough to melt the asphalt, so as to seal the joints and render them tight.

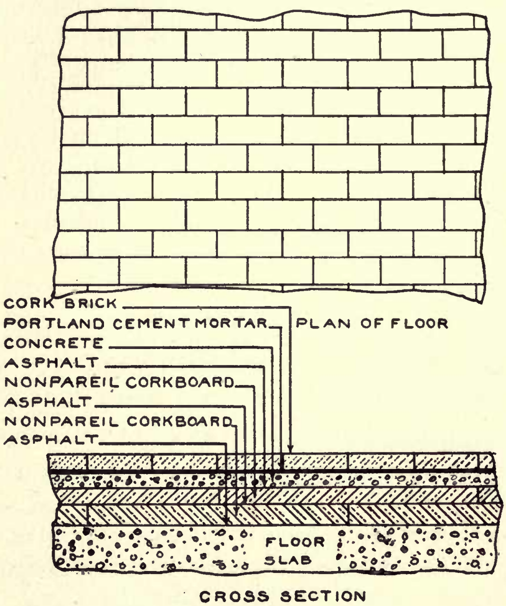
35. CONCRETE WEARING FLOORS:
Laid over corkboard insulation.

A 4-inch concrete wearing floor shall be laid down directly on top of the upper coating of asphalt as follows: Three inches of concrete, mixed in the proportion of one part of Portland cement to two and a half parts of clean, sharp sand and five parts of clean gravel or crushed stone, shall first be put down and well tamped in place until the water comes to the surface. A 1-inch finish composed of one part of Portland cement and one part of clean, sharp sand shall then be applied and troweled smooth.

NOTE: A wearing floor of the thickness specified is sufficient for any room, even where there is considerable trucking. If the traffic is light, a 3-inch floor, consisting of two inches of concrete and a 1-inch finish, may be substituted for the 4-inch floor specified.

36. CORK BRICK WEARING FLOORS:

Laid over corkboard insulation in cold storage rooms, ante-rooms, etc. (See page 81.)



A Cork Brick wearing floor shall be laid down on top of the upper coating of asphalt as follows: Two inches of concrete, mixed in the proportion of one part of Portland cement to two and one-half parts of clean, sharp sand and five parts of clean gravel or crushed stone, shall be put down and well tamped in place until the water comes to the surface. On top of the concrete, the Cork Brick shall be laid down in a ½-inch bed of Portland cement mortar, mixed in the proportion of one part of Portland cement to two parts of clean, sharp sand. The Cork Brick shall be laid tight, all transverse joints being broken. The brick shall be so tamped in place as to leave the surface of the floor reasonably smooth and level. The joints between the brick shall be grouted with neat Portland cement. The finished floor shall not be used for 48 hours.

NOTE: The minimum thickness of the concrete base on which Cork Brick can safely be laid is two inches. Hence, if the floor is installed so as to drain, the thickness of the base should be increased in proper proportion.

Miscellaneous Uses for Nonpareil Corkboard

Aside from its primary use as a cold storage insulating material, Nonpareil Corkboard is being utilized for a variety of other purposes where a heat insulating medium of high efficiency is required. The list which follows, though by no means exhaustive, will, it is believed, serve to suggest to the architect and engineer many other uses to which the material might profitably be put: **Used for Many Purposes**

(*a*) Insulating constant temperature rooms in scientific stations, industrial establishments, etc.

(*b*) Insulating Turkish bath rooms in clubs and hotels.

(*c*) Insulating rooms for the treatment of fever patients in hospitals.

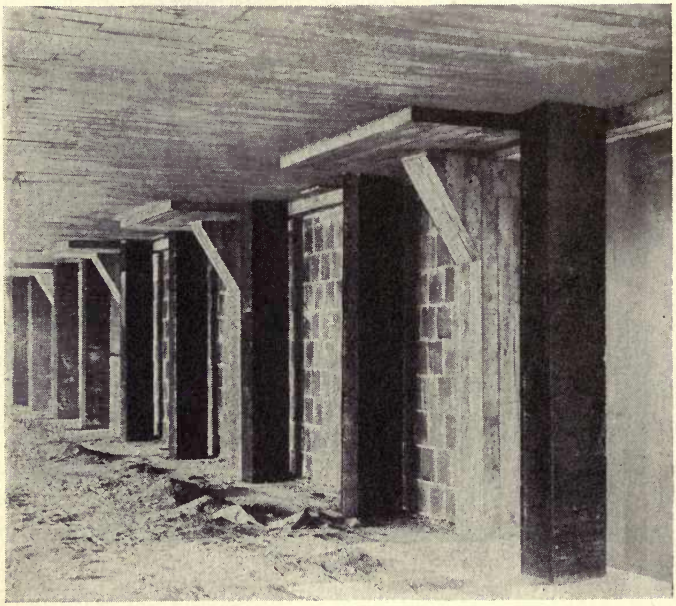
(*d*) Insulating dough rooms, mixing rooms and proving rooms in bakeries.

(*e*) Insulating drying rooms in laundries.

(*f*) Insulating the floors of stores and offices to prevent radiation of heat from boiler rooms situated immediately underneath.

(*g*) Insulating vaults and safes in office buildings.

(*h*) Insulating railway cars—not only refrigerator cars, but steel mail, baggage and passenger coaches as well. Thin sheets—¼ to ⅞ inch thick—are made especially for this purpose. Nonpareil Corkboard is also used to advantage in insulating tank cars for volatile oils and wines.



Ventilating flues built of two-inch Nonpareil Corkboard with asphalt mastic finish inside. Wagner Baking Company, Detroit, Mich. These flues are designed to ventilate the dough room by carrying off the saturated air, without condensation.

(*i*) Insulating delivery wagons for ice and ice cream.

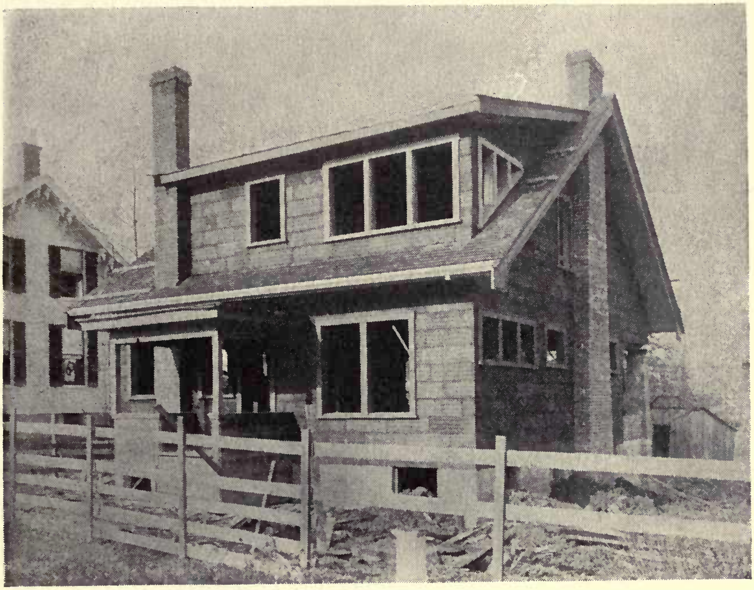
(*j*) Insulating rooms for the storage of syrups so as to maintain a reasonably constant temperature.

(*k*) Insulating humidors for the storage of cigars.

(*l*) Insulating incubators.

(*m*) Insulating cold air ventilating and cooling ducts.

(*n*) To provide a resilient base on which to lay linoleum, cork carpet and Linotile floors. In hand-ball courts, on running tracks in gymnasiums, etc., it is especially desirable that the floor be soft to the tread. Thin sheets of Nonpareil Corkboard underneath the floor covering accomplish this result at small cost. On Floors



Residence with the walls insulated with Nonpareil Corkboard.
Mr. J. S. Louis, Cincinnati, Ohio.

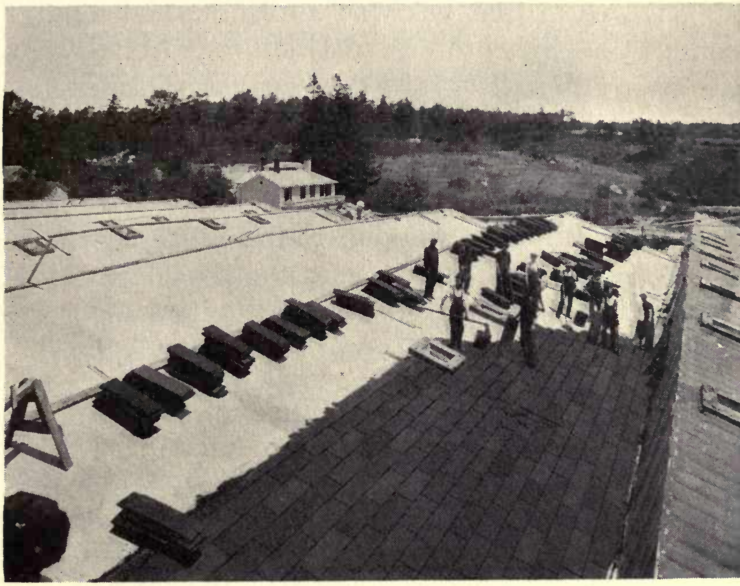
(*o*) Insulating residences. Corkboard is used extensively for this purpose in Europe. It not only effects a saving in the fuel required for heating in winter, but it makes any house much cooler and more comfortable during hot weather. For the latter reason especially, it is being used by a number of architects in the United States for insulating the roofs of houses, thus keeping the rooms in the upper For Insulating Residences story comfortable even in the hottest part of the summer. Its use, of course, can be extended to the side walls with equally good results. In frame buildings, the corkboard is simply nailed to the inside of the sheathing and then given a coat of plaster. Where walls are insulated, the sheets of cork may be nailed, if desired, to the outside of the studding, the exposed surface being covered with expanded metal lath, and then given a stucco finish. In brick, stone, concrete or hollow tile residences, the corkboard is laid up against the inside of the walls with Portland cement mortar and the exposed surface plastered.

For Insulating Roofs

(*p*) Insulating concrete roofs in textile and paper mills and in other buildings to prevent condensation inside, and conserve heat in cold weather; and conversely, to afford protection from excessive heat in summer. This is the most important of all the uses for Nonpareil Corkboard insulation which have developed outside of the cold storage field. In many industrial plants, particularly in dye and weave sheds in textile mills, the conditions of temperature and humidity are so extreme that the use of concrete roof slabs is out of the question unless they are properly insulated. Otherwise, in winter the moisture would condense on the ceiling and drop down constantly on the machinery, operatives, and product.

By applying the proper thickness of Nonpareil Corkboard to the roof slab, trouble of this nature can be entirely obviated. A notable case of this kind was the weave and dye shed at the plant of Joseph Benn & Sons, Greystone, R. I. The roof in this case consisted of concrete four inches thick, saw-tooth construction. The upper surface was insulated with two layers of one-inch Nonpareil Corkboard laid down in hot asphalt and covered with five-ply felt roofing. As a result, condensation on the ceiling has been entirely prevented, even when the temperature inside at the roof line is

Prevents Condensation and Conserve Heat



Applying Nonpareil Corkboard to roof of weave and dye shed.
Joseph Benn & Sons Company, Greystone, R. I.

100° F., the humidity 85% and the temperature outside 0° F. The insulation of the roof has, of course, reduced the amount of heat lost by radiation, and hence, less fuel is required to heat the building than would otherwise be necessary. Quite apart from the necessity of preventing condensation, the architect will frequently find that the insulation of large roof and wall areas is justified solely on the basis of the saving effected in heating the building. This is particularly true, of course, in the colder climates. In summer the insulation gives protection from the sun's rays, tending to keep the building cool and comfortable. Further information on this subject will be supplied on request.

Purchasing Insulation

Materials that are "Just as Good"

Any article that has won an established reputation always enjoys the competition of materials that are "just as good." It is the penalty of leadership. Products that are "just as good" are found everywhere, but in the cold storage insulation field, they are apt to cause more trouble than usual for the unwary purchaser, owing to the peculiar character of the service the insulation must render. It is easy to make claims, but false claims about insulation cannot be disproved until your plant is finished and operating. Even then serious defects may not reveal themselves for some time and meanwhile much of your refrigeration goes to waste.

Why Nonpareil Corkboard is Different

There are seven main reasons why Nonpareil Corkboard is different from the "just as good" kind—why it is recognized today as the standard insulation with which all others are compared:

1. In making Nonpareil Corkboard only the best cork waste is used, almost all of which is obtained from the Company's own plants in this country and abroad.

2. All the granulated cork used is carefully screened so as to take out the dust, dirt and fine particles. Corkboard that contains dust and small pieces does not bind properly and hence is apt to disintegrate in the presence of moisture.

3. The ovens are scientifically constructed, thus insuring uniform and thorough baking. Corkboard

that is not baked properly will not stand up in service. Experience has proved this absolutely.

4. The edges, ends and sides of every sheet are trimmed and sanded by machinery. Boards of uniform size and thickness are cheaper to put up and make tighter joints.

5. Every finished board is inspected four times—an expensive process, but quality is first always.

6. Through costly tests, there has been ascertained the exact amount of cork, the exact amount of pressure and the exact amount of baking required to produce boards of maximum insulating efficiency without sacrificing structural strength.

7. It is manufactured at three factories. No matter how large your requirements may be, prompt delivery is always assured.

Why it Pay to Use Nonpareil Corkboard

In the preceding sections of this book, it has been shown, first, how and why cork fulfills so completely the theoretical requirements for a good non-conductor of heat; and, second, how the insulating properties of the natural cork are actually enhanced in Nonpareil Corkboard through the process of manufacture. Taking up then the seven requirements for an ideal cold storage insulating material, it has been demonstrated:

1. That *Nonpareil Corkboard is an excellent non-conductor of heat* and is more efficient than other insulating materials. This has been proved by (*a*) tests in the Company's own testing station; (*b*) tests by Walter Kennedy, M. E.; and (*c*) tests by Professor Charles L. Norton of the Massachusetts Institute of Technology, an eminent authority on heat measurements.

2. That *Nonpareil Corkboard is nonabsorbent of moisture and therefore, durable in service.* The truth of this assertion has been evidenced (*a*) by the United States Navy Department test, which you can make yourself; (*b*) by the fact that cork is cellular and hence possesses no capillary attraction, and (*c*) by actual service records.

3. That *Nonpareil Corkboard is sanitary and odorless.* The absence of any foreign substance in Nonpareil Corkboard, such as pitch, tar or anything else that would give off a marked odor, is self-evident. The solid and compact construction that it affords leaves no harboring places for vermin.

4. That *Nonpareil Corkboard is compact—occupying but little space.* This has been proved by a concrete example showing the amount of space required by Nonpareil Corkboard as compared with other types of insulation.

5. That *Nonpareil Corkboard is structurally strong and, therefore, easy to install.* The strength of the material has been shown by actual tests. Its toughness and adaptability for structural purposes are evident to any one who examines it. The detailed specifications indicate how easy it is to install it in any type of building.

6. That *Nonpareil Corkboard is slow-burning and fire-retarding.* This has been proved (*a*) by simple tests that you can make yourself; (*b*) by elaborate experiments carried out at Beaver Falls, Pa.; (*c*) by the action of the material in actual fires; (*d*) by the test made by the Underwriters Laboratories, and the subsequent approval of the material by the National Board of Fire Underwriters.

7. That *Nonpareil Corkboard is reasonable in cost.* Here again a concrete example has been utilized to demonstrate the fact that the material will pay for itself under average conditions in a relatively short time.

Structural suggestions that will help you and your engineer to avoid the pitfalls into which others have fallen, have been placed before you. Personal assistance in solving your problems can be had from any of the Company's offices without cost or obligation. The facilities of the Construction Department are at your disposal. If you prefer to install the material yourself, printed instructions with explanatory diagrams will be supplied without additional charge.

Assistance In Solving Problems

Frankly, now, which is the better business policy? To hazard a chance on some "just as good" material, in order to save perhaps a few dollars in first cost, or to install Nonpareil Corkboard with its reputation for twenty years of good service behind it?

Which Is the Better Policy?

Acme Corkboard

Acme Corkboard, a less expensive grade of corkboard insulation manufactured by the Armstrong Cork & Insulation Company, consists of granulated cork mixed with hot asphalt, and compressed into sheets of the proper dimensions. It was put on the market originally to meet competition with boards of the type inaccurately called Impregnated Corkboard.

An Inexpensive Insulating Material

If an inexpensive form of insulation must be used, a better type than Acme Corkboard cannot be found. In its manufacture, a high grade odorless

Made of Cork and Asphalt

Factory at Beaver Falls, Pa. covering twelve acres. This plant is probably the largest in the world devoted to the manufacture of cork insulating materials.

asphalt is employed. In other similar forms of corkboard, pitch is the binder, and wherever pitch is used in any connection in insulating rooms where food stuffs, such as milk, cream, butter, eggs, ice cream, etc., are to be stored, there is great danger of tainting. Acme Corkboard can be readily erected in any type of building. It appeals especially to those architects, engineers and consumers, who remain firmly of the opinion that asphalt or pitch, in some form, should properly enter into the insulation of every cold storage room. It is peculiarly well adapted for use in breweries—fermenting cellars, chip cask cellars, racking rooms, etc.—and generally wherever, on account of excessive dampness, service conditions are particularly severe. The sheets are molded to accurate dimensions and are full size. (See following page.)

Eureka Corkboard

Made of Regranulated Cork and Asphalt

Eureka Corkboard, the third and least expensive type of corkboard insulation manufactured by the Armstrong Cork & Insulation Company, is composed of regranulated cork (the sawings and trimmings from Nonpareil Corkboard) mixed with hot asphalt and compressed in sheets of the proper size and thickness. While not quite so strong structurally as Acme Corkboard, Eureka is a good nonconductor of heat and will give satisfactory service—particularly on floors and underneath freezing tanks. It is made in four thicknesses, viz., 1½, 2, 3 and 4-inches, in sheets 12 x 36 inches.

Dimensions and Shipping Weights

Material	Thickness Inches	Number Boards Per Crate	Square Feet Per Crate	Gross Weight Per Crate Pounds	Gross Weight Per Sq.Ft. Pounds	Net Weight Per Sq.Ft. Pounds
Nonpareil Corkboard	1/4	224	672	212	.32	.25
	5/16	178	534	209	.39	.31
	3/8	148	444	212	.48	.38
	1/2	116	348	218	.63	.50
	5/8	88	264	207	.79	.62
	3/4	78	234	219	.94	.75
	7/8	66	198	203	1.03	.805
	1	18	54	48	.91	.85
	1 1/2	12	36	45	1.25	1.17
	2	9	27	46	1.73	1.62
	3	6	18	43	2.41	2.24
	4	4	12	36	3.07	2.82
	6	3	9	39	4.33	4.00
Acme Corkboard	1 1/2	12	36	68	1.88	1.8
	2	9	27	68	2.52	2.4
	3	6	18	68	3.78	3.6
	4	4	12	68	5.66	4.8
Eureka Corkboard	1 1/2	12	36	57	1.58	1.5
	2	9	27	57	2.11	2.0
	3	6	18	57	3.16	3.0
	4	4	12	57	4.75	4.0

All corkboard is made in sheets 12 x 36 inches. The standard size shipping crate (for 1-inch to 6-inch thick boards) measures 38 x 21 x 13 inches, the cubical contents being six cubic feet.

The thin sheets of Nonpareil Corkboard, viz., from 1/4-inch to 7/8-inch inclusive, are intended primarily for lining steel railway cars. They are packed in special crates 39 1/4 x 32 x 26 inches.

As cork is a natural product and hence does not run uniform in weight, all weights shown in the above table are subject to a maximum variation of 10%, over or under.

The Company reserves the right to ship not more than 5% of the corkboard on any order in short lengths—none to be shorter, however, than 12 inches. This is an advantage to the purchaser, since short lengths are required in erecting the material, to break the transverse joints between courses.

Nonpareil Corkboard one inch thick and over, is shipped from Beaver Falls, Pa., Camden, N. J., or Seville, Spain. Sheets thinner than one inch are supplied from Camden, N. J. Less than carload shipments and all shipments by steamship have to be crated; carload lots are forwarded in bulk. Shipping Points

The minimum carload weight in the territory governed by the Official, Southern, Western and Canadian Classifications, is 20,000 pounds; in the Transcontinental Classification, 24,000 pounds. Minimum Carloads

Acme Corkboard and Eureka Corkboard are shipped only from Beaver Falls, Pa. Less than carload shipments and all shipments by steamship, have to be crated; carload lots are forwarded in bulk. Shipping Points

The minimum carload weight in the territory governed by the Official and Transcontinental Classifications, is 24,000 pounds; in the Southern and Western Classifications, 30,000 pounds; in the Canadian Classification, 20,000 pounds. Minimum Carloads

Freight Rates on Corkboard

Nonpareil Corkboard takes third class in less carloads, fifth class in carloads, under the Official Classification; second class in less carloads and fourth class in carloads under the Southern, Western and Canadian Classifications. Acme and Eureka Corkboard take third class in less carloads and fifth class in carloads under the Official, Southern and Western Classifications; second class in less carloads and fourth class in carloads under the Canadian Classification. In the Transcontinental Classification, all grades of corkboard take a special commodity rate.

Granulated Cork

Various Grades

Granulated Cork is manufactured in a number of grades of different degrees of fineness. The coarsest, Unscreened Granulated Cork, the standard grade for insulating purposes, will all pass through a one-half inch mesh screen; 8/20 Granulated Cork will pass through an eight-mesh screen but be caught on a twenty-mesh screen. The following table shows the various grades of granulated cork, together with the weight per cubic foot:

Unscreened Granulated Cork	6½ lbs. per cu. ft.
Screened Granulated Cork	6¼ " " " "
8/20 Granulated Cork	10 " " " "
8/20 Rescreened Granulated Cork	7 " " " "

Shipments of all grades of Granulated Cork are made from Beaver Falls, Pa., or Camden, N. J., at the Company's option. Unscreened Granulated and Screened Granulated Cork are shipped in large bags holding about one hundred pounds each; 8/20 Granulated in small bags holding seventy pounds each, and 8/20 Rescreened Granulated Cork in bags holding fifty pounds each.

A Very Efficient Insulator

Regranulated Cork: Regranulated Cork is a by-product, consisting of the sawings and trimmings from Nonpareil Corkboard. The baking process, through which it passes, serves to enhance the insulating efficiency of the raw cork in three ways: viz., by driving off the sap, thus increasing the volume of confined air; second, by thoroughly drying it out; third, the natural gum of the cork is liquified by the heat and spreads out over the surface of each particle, thus effectually preventing the re-entrance of moisture. As a hcat insulator, Regranulated Cork surpasses in efficiency all other loose insulating materials. It has the added advantage of being comparatively cheap.

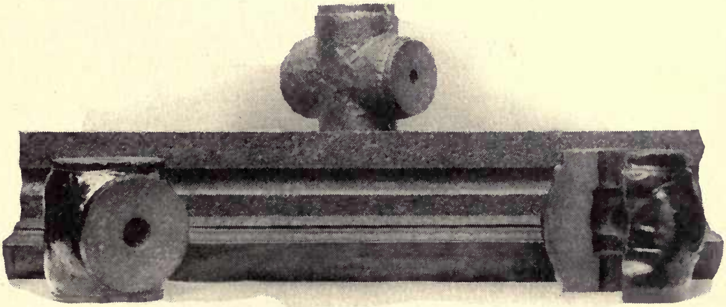
Regranulated Cork is chocolate brown in color, and is manufactured in two grades:

Fine Regranulated Cork	7 lbs. per cu. ft.
Coarse Regranulated Cork	6 " " " "

All quotations on Regranulated Cork are made subject to prior sale. Shipment is made from either Beaver Falls, Pa., or Camden, N. J., at the Company's option. Regranulated Cork is shipped in small bags holding from thirty to forty pounds each.

Freight Rates

Both Granulated and Regranulated Cork take first class in less carloads, third class in carloads, (with a minimum carload weight of 12,000 pounds) under the Official, Southern, Western and Canadian Classifications; first class in less carloads, and a special commodity rate in carloads (24,000 pounds) under the Transcontinental Classification.



Nonpareil Cork Covering

Nonpareil Cork Covering

For Cold Pipes

Made of Pure Granulated Cork

Nonpareil Cork Covering is designed especially for the insulation of brine, ammonia, ice water, beer and cold water lines; accumulators, coolers, cylindrical tanks, and filters. It consists of pure granulated cork, compressed and baked in molds of proper shape to fit the different sizes of pipes and the various fittings in ordinary use. It is coated inside and out with a mineral rubber finish and is applied with waterproof cement on the joints, thus rendering them impervious to moisture.

Its Merits

On account of the cellular structure of the cork, Nonpareil Cork Covering possesses maximum insulating efficiency. For the same reason, it does not absorb moisture and hence, is remarkably durable in service. It is, moreover, light, clean, neat in appearance, and easy to apply.

Four Thicknesses

Nonpareil Cork Covering is manufactured in four thicknesses to meet different service conditions. If satisfactory results are to be secured, the proper grade and the necessary fitting covers must be used, and the material carefully applied.

1. *Standard Brine Covering,* from two inches to three inches thick, is designed for brine and ammonia gas lines, and generally where the refrigerant ranges from 0° Fahrenheit to 25° Fahrenheit.

2. *Special Thick Brine Covering,* from three inches to four inches in thickness, is for brine lines, where the temperature of the refrigerant runs below 0° Fahrenheit.

3. *Ice Water Covering,* approximately one and one-half inches thick, is intended for use on refrigerated drinking water, liquid ammonia, and beer lines, and generally where temperatures of 25° to 45° Fahrenheit are carried.

4. *Cold Water Covering,* for pipes up to and including four inches, approximately one inch thick, is for use on cold water piping to prevent sweating. For sizes larger than four inches, Ice Water Covering is used.

Nonpareil Cork Lagging, beveled to any desired radius, is furnished for cylindrical brine coolers, ice water tanks, filters, large size pipes, etc. This material is of the same density as Nonpareil Cork Covering and weighs 1.25 pounds per board foot. Regular Nonpareil Corkboard is not dense enough for service of this severe character. **Nonpareil Cork Lagging**

A sixty-four page book entitled, "*Nonpareil Cork Covering,*" describing the material in detail, together with price list and samples, will be cheerfully forwarded on request. A separate publication, "*Drinking Water Systems,*" may be had by those interested in the use of Cork Covering on drinking water lines. **Catalogues and Samples**

Nonpareil High Pressure Covering

For Steam Lines

The increasing tendency to use steam at high pressures and the growing popularity of superheated steam, has created a demand for a more efficient type of insulation for steam lines—a demand which is fully met by Nonpareil High Pressure Covering. **A Better Steam Covering**

This covering is distinctive because it is the only covering made of diatomaceous earth and asbestos.

It contains no cork whatever. Diatomaceous earth is practically pure silica, being composed of the skeletons or shells of microscopic plants, that grew in the sea ages ago. There are literally millions of these minute diatoms to the cubic inch, each hollow and filled with air. The remarkable heat insulating value of this earth has long been recognized, but until a few years ago, no practical means was available by which it could be bonded together in the various shapes requisite for insulating purposes. This problem was finally solved, and the result is Nonpareil High Pressure Covering.

Made of Diatomaceous Earth

Compared with other high pressure coverings, Nonpareil High Pressure Covering is not only a better nonconductor of heat, but will withstand higher temperatures without calcining or disintegrating. It is particularly well suited, therefore, for the insulation of superheated steam surfaces. Moreover, it will bear repeated wetting and drying without injury, and for this reason is the ideal form of covering for underground steam lines. It is easy to apply—being furnished in sectional, block and plastic cement form—and is reasonable in price.

Its Merits

A book entitled, "*Nonpareil High Pressure Covering,*" and samples may be had on application. Prices and estimates on the covering applied will be cheerfully furnished by the Company's branches and representatives throughout the country. They are also prepared, without placing the owner under obligation, to investigate thoroughly any heat insulating problem, and suggest what should be done to secure the most economical results. It pays to design and install steam covering on a scientific basis.

Catalogue and Engineering Service

Nonpareil Insulating Brick

For Industrial Furnaces, Ovens, Boiler Settings, Etc.

A New Type of Insulating Material

For many years there has existed a real need for a heat insulating material which would combine low heat conductivity, with sufficient strength to enable it to be built in as a part of the structure it is designed to insulate. This need has been particularly felt in connection with boiler settings, industrial furnaces, and ovens of various descriptions, where the insulating medium must, in addition to the two requirements just mentioned, be able to resist relatively high temperatures.

Used for Years in Europe

To meet this demand, Nonpareil Insulating Brick were placed on the American market in 1913. In Europe, a similar product had been available and, in fact, in general use for fifteen years previous; hence, Nonpareil Brick are not in any sense experimental in character. They are being used under a variety of conditions and are giving universal satisfaction.

Made of Diatomaceo Earth and Cork

Nonpareil Insulating Brick are composed of diatomaceous earth and finely ground cork, molded into brick form and then fired. The cork is thus burned out, leaving the brick extremely porous in texture and a light terra cotta in color. As Nonpareil Insulating Brick contain not only the "dead-air" confined in the diatoms (see page 138) but also the pores formed when the cork is burned out, their insulating efficiency is exceptionally high. They actually transmit but one-tenth as much heat as fire brick or common brick. In other words, a single course of Nonpareil Insulating Brick $4\frac{1}{2}$ inches thick is equal to 45 inches of fire brick or common brick in insulating value.

Nonpareil Brick are very light, the standard size 9 x 4½ x 2½ inches, weighing but 1½ pounds. Nevertheless, they will sustain a crushing load of more than ten tons to the square foot, which is sufficient to carry any load encountered under average conditions. They are very easy to install, being made in standard fire brick sizes and shapes, and are laid up in a special insulating cement, which has practically the same heat retarding properties as the brick themselves. While in no sense a refractory material—being intended simply to back up fire brick in places where the retention of heat is desired—Nonpareil Brick will withstand temperatures of 1800° Fahrenheit without shrinkage or change of form. This is higher than any temperature they will be subjected to, if correctly installed.

Advantages

Detailed information regarding Nonpareil Insulating Brick is given in the following booklets, which, with a sample brick, will be supplied free of charge, on request:

In boiler settings—"*Saving Fuel.*"

In industrial furnaces and ovens—"*Good Furnaces Made Better.*"

In bread baking ovens—"*Comfort and Economy in the Bakery.*"

Nonpareil Cork Machinery Isolation

For Deadening the Noise of Machinery

Nonpareil Cork Machinery Isolation is similar to Nonpareil Corkboard, except that it is much denser. It is used to deaden the noise and diminish the vibration of fans, motors, presses, pumps, refrigerating machinery, engines, conveyors, etc.

It is supplied in sheets 12 x 36 inches, in the following thicknesses: ½, ¾, 1, 1½, 2, 3, 4, 5 and 6 inches. Samples and further information will be supplied on request.

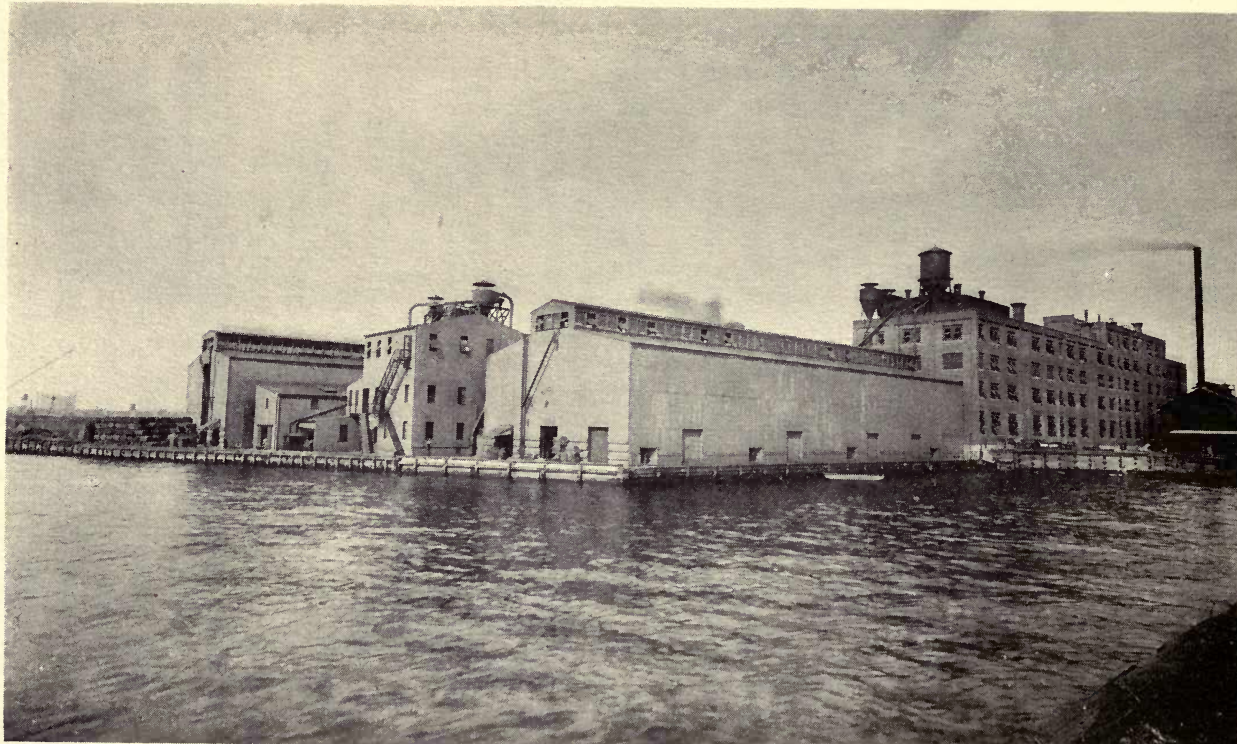
Linotile Floors

For Offices, Stores, Etc.

Linotile is a composition in which powdered cork, wood flour and linseed oil predominate. It comes in tile form, one-quarter inch thick and in various shapes and sizes, including sanitary cove. It is applicable to any base—wood, concrete or metal. There are eleven colors—light and dark shades of brown, green, gray and blue, one shade of red, and black and white. But the mere mention of the colors conveys no conception of the mellow, glossless beauty of Linotile. It must be seen to be appreciated. **Description**

By the use of Linotile, a floor can be made to express faithfully the spirit of the room in which it appears. It is difficult indeed to conceive of any desired effect, either in color or form, which cannot be executed in this material. Moreover, it is just as good, comfortable and enduring as it is beautiful. It presents none of the objectionable features so frequently met with in other floors. For, in addition to its other advantages, it is resilient, practically silent under foot, thoroughly sanitary, odorless and reasonable in cost. There is no better floor for offices, stores, banks, theatres, museums, hospitals, libraries, churches, kitchens, pantries, bath rooms, elevators, etc., than Linotile. **Its Merits**

Catalogue entitled, "*Linotile Floors,*" samples and estimates, will be supplied on request. **Catalogue**



Factory at Camden, N. J. This plant, covering six acres, is devoted exclusively to the manufacture of Nonpareil Corkboard and Nonpareil Cork Pipe Covering.

Factories

The Company's factories at Beaver Falls, Pa., and Camden, N. J., covering twelve and six acres respectively, are probably the largest plants in the world devoted to the manufacture of cork insulating materials. Nonpareil Corkboard is made at both these plants, and also at Seville, Spain. Export orders are usually shipped from the latter point. Acme and Eureka Corkboard, and Nonpareil Insulating Brick are made exclusively at Beaver Falls, Pa. Nonpareil Cork Covering is produced only at the Camden factory, while a fourth plant, situated at Oakdale, Pa., is given over entirely to the manufacture of Nonpareil High Pressure Covering. The capacity of these plants is ample to take care of orders of any size promptly. A large supply of all products is carried constantly in stock, not only at the factories, but also in warehouses situated in the principal cities of the United States and Canada.

Four Insulation Factories with Ample Capacity

Branch Offices and Representatives

The Company has offices in the following cities: Pittsburgh, New York, Boston, Rochester, Atlanta, Cleveland, Cincinnati, Detroit, Indianapolis, Chicago, St. Louis, Minneapolis, Kansas City, Mo., and Dallas. Direct representatives are located in Philadelphia, Baltimore, New Orleans, San Francisco, Los Angeles, Portland, Ore., Seattle, Tacoma, Spokane, Great Falls, Mont., Honolulu, T. H. and Manila, P. I. Canadian business is handled by the Armstrong Cork & Insulation Company, Ltd., with offices in Montreal and Toronto, and direct representatives in Vancouver, B. C.

Throughout the United States and Canada

The Armstrong Line

Corks of Every Description
Washers and Gaskets

Bungs and Taps | Insoles | Handles

Bath and Table Mats

Life Preservers | Buoys

Yacht Fenders

Armstrong's Linoleum—plain, printed and inlaid

Nonpareil Cork Floor Tiling—for libraries, museums, billiard rooms, bath rooms, etc.

Armstrong's Linotile—for flooring offices, banks, theatres, kitchens, pantries, elevators, etc.

Cork Paving Brick—for stables, shipping platforms, warehouses, etc.

Nonpareil, Acme and Eureka Corkboard—for insulating cold storage rooms

Nonpareil Cork Covering—for cold pipes

Nonpareil High Pressure Covering—for steam lines, boilers, etc.

Nonpareil Insulating Brick—for boiler settings, furnaces, ovens, etc.

Machinery Isolation—for deadening the noise of fans, presses and motors

Granulated Cork
Cork Specialties of Every Description

Nonpareil Heat Insulating Materials received the Grand Prize—the highest possible award—at the Panama-Pacific International Exposition, San Francisco, 1915.

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Publicity Department
Armstrong Cork & Insulation Co.
Pittsburgh, Pa.

THE CORDAY & GROSS COMPANY, CLEVELAND