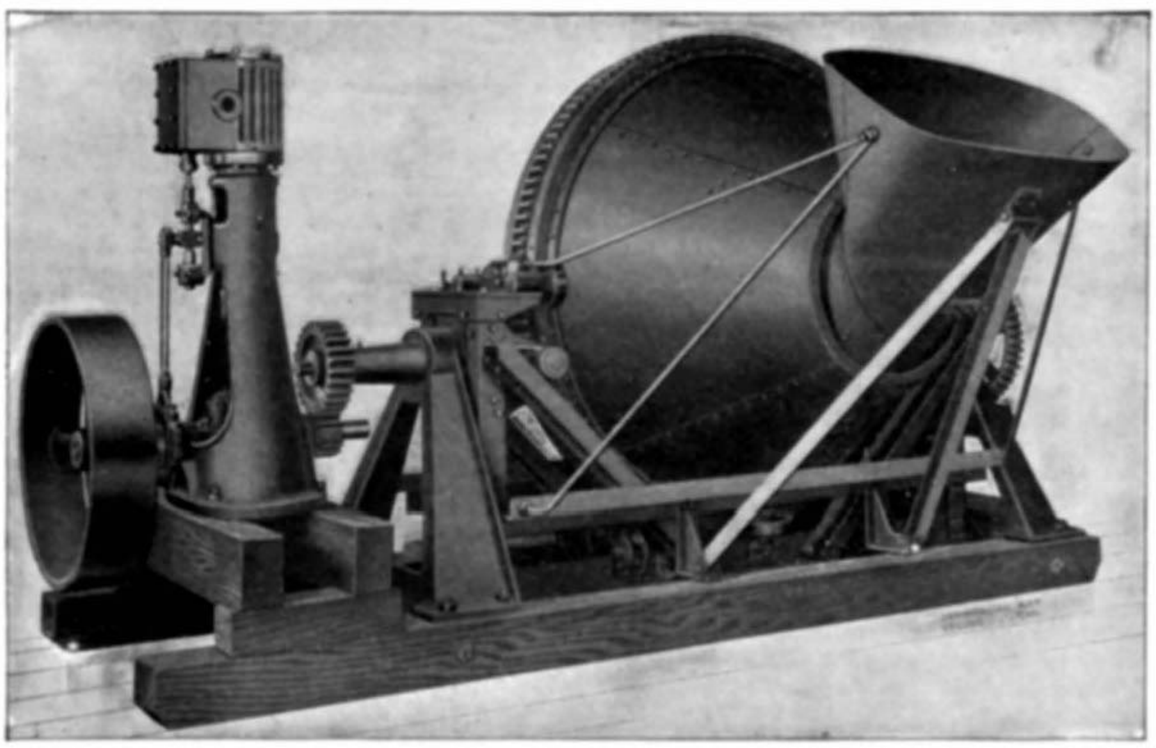
In Niagara Falls the popular power for the operation of factories of all kinds is electrical power, and the Cataract Ice Company has installed a 100-horse-power, 2,200-volt, Westinghouse induction motor to operate an ammonia compressor; a 5-horse-power motor of the same type, 220 volts, that operates an air compressor; a 3-horse-power motor of same type and voltage that operates the brine pump; and a 5-horse-power motor to operate an electric crane. The electric current is received from the Niagara Falls Hydraulic Power and Manufacturing Company at 2,200 volts, and for the operation of the small motors this voltage is stepped down to 220 volts.

In this Niagara Falls plant the tank occupies a space of 98 feet long, 15½ feet wide, and is 9 feet 9 inches high. This tank is divided into eight compartments, each compartment containing four plates. One of these eight compartments is emptied daily, taking out eight cakes of ice, the approximate weight of each cake being about four tons; so that the plant has a daily capacity of about thirty-two tons. The weight of the daily output varies, of course, according to the thickness of the ice. Each cake of ice made is about 15 feet 3 inches by 9 feet 6 inches wide, clear and transparent. Into each cake of ice, about six feet apart, two iron rods five feet long and about one inch in diameter are frozen, and in drawing the ice these rods are engaged by hooks at the ends of chains on the electric crane. After being raised from the compartment where it was made, each cake of ice is conveyed by the crane to the rear of the building, where it is placed on a tip table and dropped to a horizontal position. At the present time saws operated by hand are used to cut the ice into small cakes, but an electrically-operated saw is to be installed. Out of each of the huge cakes 32 small cakes are made, and these are chuted to a storage room, where the ice is kept for delivery to the company's many wagons. The plant has a storage capacity of 3,000 tons.



POWER MIXER FOR MIXING CONCRETE.

It is evident that in a plant of this kind, the dangers that arise from using ice from streams that are polluted by sewage are avoided. It may be claimed that natural ice is just as good as ice artificially made, if the water supply is pure in the stream or pond from which the natural ice is taken. In the plant of the Cataract Ice Company, the water is taken from the city mains. It passes through a condenser and is pumped to the top of the building, where it is discharged into a tank of large capacity equipped with live steam coils. Here the temperature of the water is raised to 160 degrees, and by gravitation the water passes down through a flat cooler, which reduces it to a temperature of about 90 degrees before passing through the filters, which have a capacity of about 15,000 gallons per day. From the filters it passes to the fore-cooler, or water storage tank. From this tank it passes, as it is used, by gravitation to the freezing compartments.

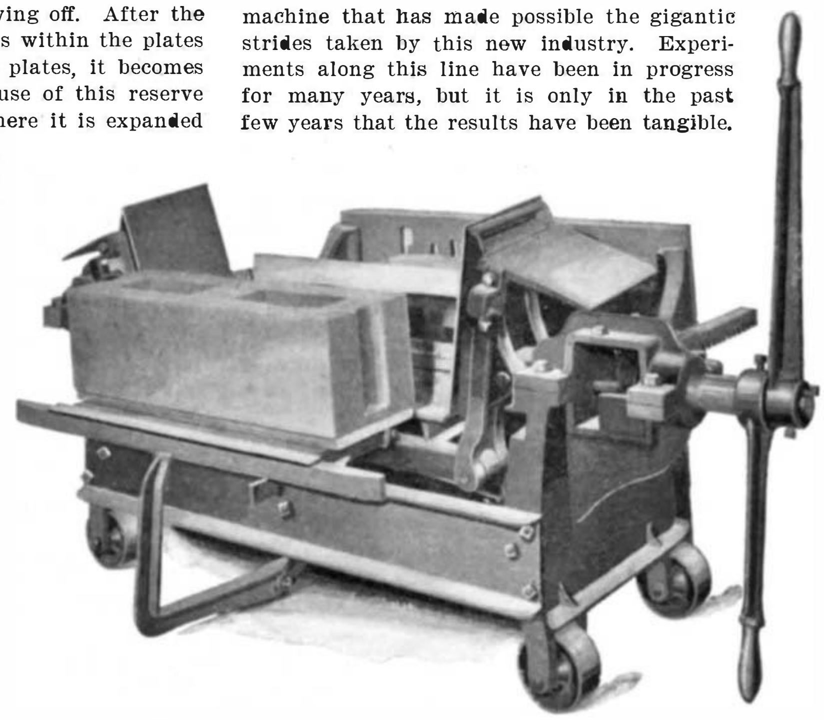
In the operation of the plant, the anhydrous ammonia is compressed, and thereby heated and converted to a gas. It is then passed to a condenser, where it is brought into contact with cold water, thus reducing it in temperature to the temperature of the water, and converting it back to a liquid. It is then expanded into the freezing coils, which are incased in the freezing plates. These plates being submerged in the water, the ice forms on their outside, and after a period of eight days a cake of ice has developed or grown. The system used is known as the direct expansion system, but by it the trouble with old direct expansion plants is obviated by the introduction of a reserve line, which is used in thawing off. After the hot gas has passed through the coils within the plates in thawing off the cakes from the plates, it becomes liquefied. It is then conveyed by use of this reserve header to another compartment, where it is expanded into the coils. It will be observed that in thawing off the plates are used as a condenser. This eliminates the possibility of the liquid gas going back to the compressor, which was the difficulty met with in operating the old style of direct expansion plate plants.

The ice made in this plant has good lasting and refrigerating qualities. As it takes eight days for a cake of ice to develop, it is evident that could the period of freezing be reduced, the plant investment would be materially lessened. Experts are now trying to accomplish this.

HOLLOW CONCRETE BUILDING BLOCKS: THEIR MANUFACTURE AND USE.

BY L. B. POWELL.

The comparatively recent advent of hollow concrete blocks into building construction is probably one of the most important innovations in the building industry, and one that is yet in its infancy. The use of concrete as building material is not recent, however, as there are still in existence dikes, dams, roadways, etc., built by the Romans of material corresponding almost exactly with our present-day concrete; it is the introduction of the hollow concrete building block machine that has made possible the gigantic strides taken by this new industry. Experiments along this line have been in progress for many years, but it is only in the past few years that the results have been tangible.



The final position of machine showing block automatically delivered, away from the molds, in a position to be carried away for "curing."

AUTOMATIC BLOCK MACHINE FOR MAKING HOLLOW CONCRETE BUILDING BLOCKS.

The natural cement which was formerly used in concrete construction has been almost entirely replaced by its superior, artificial cement, and it is only with the latter cement that any advantageous results have been accomplished. It is interesting to note that where formerly a European Portland cement was specified as the standard of excellence, in recent years American Portland cement has been so improved by exhaustive and expensive experiments that the domestic production is now conceded to be superior in every way to the foreign article. That an industry so new to this country, and one requiring so high a degree of technical knowledge, has leaped to first place, is doubtless due to the superiority of both raw material and method of production. Probably the best proof of the superiority of our product will be shown by a comparison of our production in 1890 of 300,000 barrels with that in 1903 of 21,000,000 barrels.

Concrete, as is well known, is a perfect mixture of an aggregate, such as crushed stone, with sand and cement, the aggregate forming the body of the mass, while the sand fills up the voids between the aggregates, and the cement fills up the voids between the grains of sand. As the purpose of the concrete is to take the place of stone, it is therefore necessary that the mixture be so perfectly proportioned that each aggregate and each grain of sand has a coating of cement paste, so that when the block has dried thoroughly, the mass will be held in perfect rigidity by the hardening of the cement bond. The aggregates used may be of either gravel, crushed granite, quartz, or trap rock, and should be clean and free from dust, clay, or iron rust, which will resist the adhesion of the cement bond. The sand should be as pure silica as possible, should be washed clean to be free from lime, vegetable matter, etc., and should be as sharp as possible. The proportions used in the mix will de-

LAYING HOLLOW CONCRETE BUILDING BLOCKS.

pend on the sizes of the sand and the aggregates, and can only be determined by testing. This is one of the most important items to be considered, and none of the proportional rules laid down by the manufacturers of hollow concrete building-block machines should be followed, but the proper proportions should be determined by careful and repeated tests, measuring each ingredient carefully until a perfect mix has been secured. Power mixers should be used wherever possible, as by their use a more thoroughly uniform mix can be secured; and where there are any number of blocks to be made, the power mixer will be found to be not only the best but the cheapest, as the time and expense of mixing are considerably reduced thereby, while the quality of the mix is far superior to that of hand mixed. However, where hand mixing is found advisable, the aggregates should be spread evenly over the mixing board at a uniform depth, the sand spread over this, and the dry cement over the sand. Then this should be turned over at least three times, which should result, if properly turned, in the mass being free from streaks. Then the mass should be sprinkled and turned three times more, sprinkling at each turn, and then smoothing over to test for streaks. If streaks should appear, turn until they disappear. Lime is sometimes used to give a white finish and produce a hard waterproof block, but when it is considered that the life of lime is only from six to sixteen years, while good concrete should last forever, it will readily be realized that a block containing lime will in a comparatively short time crumble and deteriorate. In a like manner the use of vitriol, sodium, soda, argol, salt, and other chemicals should be discouraged, as while they tend to harden a block in a shorter time, their life is short compared with the life of a good concrete building block. A good waterproof block may be made by mixing five per cent of dry powdered alum with the dry cement and ten per cent of a saturated solution of common washing soap with the water used in making the concrete. This will not affect the life of the block in any way, and will result in a perfectly waterproof block being turned out.

With so many different styles of machines at such contrasted prices on the market, it will doubtless be a matter of uncertainty which make to use, and on this point the writer, for obvious reasons, cannot advise. The principle of the process is identical with that of molding, the block being nothing more than a quantity of concrete tamped in a mold and dried. A carpenter could in a few hours make a block mold from wood that would form the first blocks in a satisfactory manner, but the mold would soon be sprung out of shape upon subsequent tamping of the blocks.

The principal reason for buying a machine at all is to secure some means of making your blocks in as economical a manner as possible, at the same time securing one that will produce perfectly satisfactory blocks. It would therefore be best to secure a tried machine, that has been in use long enough to demonstrate its value both as regards quality of product and also rapidity of production, as upon these depend the ultimate success of your venture. The only reason one would have need to buy a block machine would be to secure the advantages of labor saving, high quality of product, and rapidity of production, and for that reason the best machine on the market is the cheapest at any price. Many machines are so constructed that the block is formed face downward, so that the face of the block can be made of somewhat finer material, that can be waterproofed and colored to suit the requirements of the users. On such machines it will be found possible to make the face hard and waterproof without waterproofing the entire block, which is indeed not necessary if the block is made with a waterproof face; also, it will be found possible by using a specially-prepared and colored mix for the face of the block, to produce blocks of any desired color. After a layer of facing is placed in the machine, concrete is filled in and tamped by layers, the tamping being done either by hand or by power tamps. This is an important item, and one that must be considered carefully, as poor tamping will spoil blocks perfect in mix and mold. Pressure will not form good blocks, as under pressure the concrete will be made compact at the top and bottom in thin layers, which will act as a seal to prevent the air from escaping. Continued pressure will compress the air, and when the pressure is removed, the air expands, forcing its way through the particles of sand and making a weak, porous stone, easily subject to disintegration.

Light and frequent tamping, however, works the air out and packs the grains of sand tightly in the voids of the aggregates. When the mold is well filled and tamped, the block should be released from the machine and set aside to be cured. At this point it will be wise to remember that a newly-made block has no more strength than so much damp sand, and it should not be disturbed by handling after being molded, as a crack once started will never unite, and will utterly destroy the value of the block as a building factor.

As soon as the block has set enough to prevent the surface and corners being washed off, the sprinkling should begin, and the block kept well sprinkled for the first day. After that time it should be covered with hay, straw, burlap, or any material capable of retaining moisture, and this covering kept moist for six days. If this is not possible, the blocks should be sprayed by a flowing stream continuously for that time. It should always be remembered that the interior of the block is wet through and through by the nature of the mixture, and to insure uniform crystallization, the exterior should be as thoroughly moist as the interior. After having been cured for seven days in the shade, the block should be placed in the sun and dried for ten days, after which time the block will be ready for use on the wall. A well-made block will easily have a tensile strength of 240 pounds to the square inch and a crushing strength of 1,000 pounds to the cubic inch, thus proving itself far superior to brick, while it is now well known that concrete building blocks will outlive any kind of natural stone. On an improved automatic machine four men can make in one day blocks that will equal 6,000 bricks, wall measure. These blocks can be laid in one-third of the time required to lay the same wall measure of brick, and by inexperienced labor, with one-quarter of the mortar required for the brick. The hollow concrete building block has the decided advantage of insuring a good circulation of air inside the wall to prevent dampness, and presents possibilities, by its method of manufacture, that are peculiar to no other building factor. Cut stone of any nature can be imitated so successfully as to defy detection, and an imitation brownstone house can be made from concrete blocks cheaper than an ordinary brick house. The three main things to consider in this manufacture are mixing, tamping, and curing, careful attention to these three points going far to insure the best quality of product.

Fires from Moving-Picture Exhibitions.

BY BAXTER MORTON.

The increased use of moving-picture apparatus for exhibition purposes in recent years has been accompanied by a large number of more or less serious fires traceable to the moving-picture apparatus or to the wires used for supplying electric current for the apparatus. The disastrous character of some of these fires has attracted attention in many quarters to the importance of placing proper restrictions upon the use of moving-picture machines and of so constructing moving-picture apparatus that neither accident nor careless handling can lead to a conflagration. In a number of cities ordinances have been passed requiring all users of moving-picture machines to have their apparatus officially inspected and approved before a permit for its use can be obtained. Such inspections have been required for a considerable period in New York and Boston, and recently an act has been passed by the Legislature of Massachusetts placing all moving picture exhibitions in that State under the control of the State police. The need of such an act was clearly shown by the occurrence within six weeks of fires due to moving-picture exhibitions in Haverhill, Salem, and Lynn, which resulted in damage amounting to $60,000 and caused many persons to be seriously injured.

In a few instances, the fires resulting from moving-picture exhibitions have been due to defective or improper electric wiring, especially to the use of wires too small to carry safely the current ranging from twenty-five to thirty-five amperes, required for the successful operation of a moving-picture machine equipped with electric lighting devices. But most of the disastrous fires that have had their origin in moving-picture exhibitions have been due to accident or to the carelessness of the operator, and it is the principal duty of the officers charged with the inspection of moving-picture apparatus to see that the apparatus used in every exhibition is of such character that neither of these causes can give rise to a conflagration.

The danger attending the use of moving-picture apparatus is due to the highly inflammable character of the celluloid film bearing the pictures and to the intense heat produced where the light is condensed upon the film. This heat is sufficient to ignite the film at the projection aperture if the light is allowed to rest continuously upon one portion of the film for a few seconds, but when the machine is in operation the film of course travels so rapidly across the projection aperture that the heat is without effect upon the film. The projection aperture, therefore, is the point at which the film is most apt to take fire, and in almost every instance the ignition takes place because a portion of the film is held stationary at the projection aperture for a time. This may be brought about in various ways. The film may break below the projection aperture; the feed mechanism may become jammed and inoperative; it may lose its hold on the film; the crank may become loose on the shaft of the feed mechanism so that its turning will not feed the film forward; a small fragment may be torn off the film and lodge in the projection aperture where it will be exposed to the full heating effect of the light; or the operator may stop turning the crank of the film feed mechanism for any one of a variety of reasons. He may become faint or giddy from the heat or from escaping gas; his attention may be suddenly distracted and he may forget to keep the film feed mechanism in motion; or he may stop the feed of the film intentionally and neglect to cut off the light. Fires have resulted more than once from each of the foregoing causes, and it is practically impossible to construct moving-picture apparatus in such a way as to prevent the film from occasionally taking fire at the projection aperture. It is possible, however, to prevent serious consequences from the ignition of the film at this point, and this may be done by simply preventing the fire from following the film from the projection aperture to the reels upon which the film is wound. Ordinarily, these reels have from eight hundred to twelve hundred feet of film wound on them, consequently, if a flame reaches either of these reels the fire that results is so large, so hot and so difficult to extinguish that great damage to the building is almost certain to result, to say nothing of the panic that is always caused when a flame of any size breaks out in a place of public entertainment. If, however, the film burns only at the projection aperture, the flame will be small and do no damage. To limit any fire that may occur from a moving-picture exhibition to a few inches of the film, it is only necessary to inclose both the film supply reel and the take-up reel in fireproof chambers and to provide valves leading into said chambers through which the film can pass freely while the film feed mechanism is in operation, but which will close instantly when the film feed mechanism ceases to operate or the tension upon the film is relaxed. If the film supply reel and take-up reel are inclosed in such fireproof chambers or magazines, the ignition of the film at the projecting aperture is a matter of very little consequence, as the burning of the film at that point immediately causes a reduction of the tension on the film and permits the valves through which the film passes into the magazines to close and so prevent absolutely the passage of the flame into the magazines. Properly constructed magazines for the film supply reel and take-up reel can be applied at very small cost to any moving-picture machine, and if the machine is equipped with such magazines it may even be overturned without causing any serious damage.

Other methods of preventing flames at the projection aperture from reaching the reels of film have been proposed, such as a non-inflammable plate of considerable size arranged above the projection aperture and extending rearward and to the sides for a considerable distance. Such a plate will sometimes prevent a flame at the projection aperture from reaching the film on the supply reel, but it is by no means as certain in its action as the magazines already mentioned, for the film above the plate is fully exposed, and if the flame rises above the edge of the plate it may strike the exposed film and set fire to the entire reel. Another device which has been proposed to prevent the transmission of a flame from the projection aperture to the film reels consists of a pair of flat tubes or guides extending above and below the projection aperture and made of non-inflammable material, the idea being that in the small space afforded by these guides for the passage of the film a flame will be extinguished. As a rule this device operates successfully, but as the reels themselves are exposed, a flame flaring up suddenly at the projection aperture may reach one of the film reels in spite of the guides.

A plan of preventing fires from the use of moving-picture apparatus that has been adopted in England to a considerable extent is to inclose the entire apparatus in a fireproof box large enough to contain the operator also and to lock the operator in during the exhibition. This plan has the merit of making operators careful, but many grounds of objection to it are obvious, and American operators of moving-picture apparatus are unwilling to be locked in such a box while giving an exhibition.

Considered from all points of view, the most satisfactory and thoroughly reliable means for rendering moving-picture apparatus safe is a fireproof magazine for the film supply reel and a similar magazine for the take-up reel. Such magazines answer all the requirements and have the advantage of being readily portable and of being easy to apply to any standard moving-picture machine.

The earliest wooden bridges were built by expert carpenters. The work was done by contract, very much the same as building work is done at the present day, except that the builder was also the designer. The builder would buy suitable timber or have it sawed to order at conveniently located saw-mills, and any ironwork needed in the construction of the bridge, such as rods, bolts, or bars, he would obtain at a local blacksmith shop, and frame and erect the bridge in place, ready for traffic. The same methods were also used in building the early iron highway bridges. Each of these builders had his own type of bridge and his own special details. At that time there was generally but little competition, as very few had any knowledge of bridge building, and each one controlled a certain territory.