HOUSE CONSTRUCTION. III.

Precautions against Fire.

In a house built of stone or brick no floor-beams should extend more than four inches into the wall; this has been found by calculation and experiment to be sufficient for ordinary floor-beams. The ends of the beams should be cut beveling, as in the accompanying cut, Fig. 2. This is done to prevent the destruction of the wall by the fall of the floor in case of fire. If left square the part in the wall will act as the short arm of a powerful lever, whose long arm, as the floor falls, pries the wall out with considerable force. If there are interior brick walls care should be taken that the ends of the beams resting on such a wall do not abut, or that the beams do not run entirely through the wall. By means of abutting beams fire is often communicated from one part of a building to another.

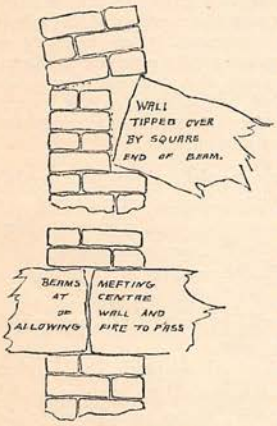

FIG. 1.—BAD METHODS OF RESTING BEAMS ON WALLS.

An undeafened floor, as ordinarily constructed, is from its form a dangerous ally of fire. Being nothing more than a series of boxes formed of the beams, the floor boards, and the ceiling, bristling with splinters, and often partly filled with shavings and chips left by careless workmen, the flames, when once they reach such a floor, become almost uncontrollable. The flames may travel from one floor to another, by way of the large number of small flues on the inside face of the brick or stone wall formed by furring strips, which are pieces of wood, usually an inch or more in thickness, placed vertically, about a foot apart, on the outside walls to support the laths and plaster, so that should any moisture strike through, the plastered surface will remain intact. A good way to overcome this difficulty is to run the floor-boards well up to the walls, and when the furring strips are on fill in between them to about a foot above the floor with gauged mortar, which is ordinary lime mortar and plaster-of-Paris. Or these open spaces may be filled to the same height with "mineral wool." If the furring is wide, or the space between the wall and the inside finish will permit, one or two courses of brick in mortar laid on the floor-boards would cut off communication between the cellar and the space behind the plastering. It is often advisable to stiffen the furring with angular bridging, the same as in partitions, and a second fire-stop may be procured by using coarse mortar and chips on top of the bridging all around the building, which, with floors properly deafened, would render its destruction by fire rather slow and difficult.

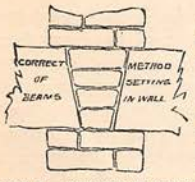

FIG. 2.—PROPER METHOD OF RESTING BEAMS ON WALLS.

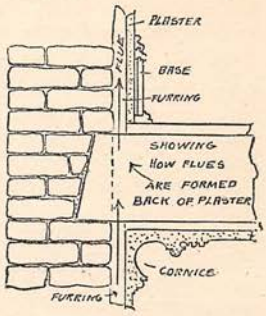

FIG. 3.—SPACE USUALLY LEFT BETWEEN PLASTERING AND BRICK WALL, WHICH MAY ACT AS A FIRE FLUE.

The floors should be deafened with "mineral wool," or with hollow brick flushed with mortar, the brick being laid on cleats between the beams; or with mortar and cinder deafening; or with an ordinary seven-eighth inch thick board floor, diagonally laid on the beams and then covered with iron plate or asbestos flooring felt, the finishing floor being laid on top. Somewhat similar methods may be employed for frame houses, care being taken not to forget the brick fire-stop under the first-story beams, which was described in the March number of this magazine.

In a frame house the outside surface of the chimney is usually plastered to lessen the danger of sparks passing through the joints of the masonry; particular

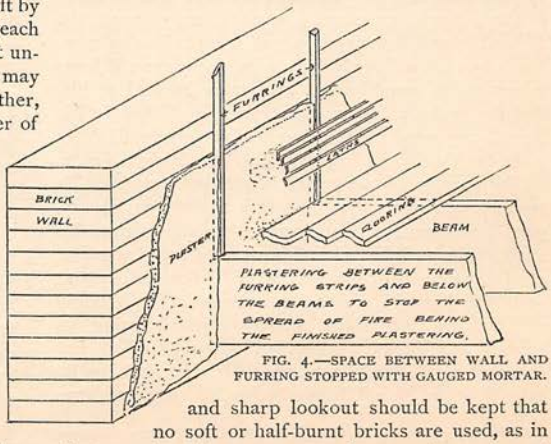

FIG. 4.—SPACE BETWEEN WALL AND FURRING STOPPED WITH GAUGED MORTAR.

and sharp lookout should be kept that no soft or half-burnt bricks are used, as in that case the chimneys may crack open at any moment after being inclosed by furring. Care should be taken, also, to have the chimneys come in the middle of the openings intended for them, as masons rarely think of questioning the accuracy of carpenters. The chimney is

carried up, on the supposition that the opening is right, but if the opening is found to be in the wrong position the chimney is shifted over, so that it rests on the trimmer beam. The trimmer beam runs at each side of, and should be twelve inches from, the inside face of the chimney flue; and the "header," or beam in front of the chimney, between the trimmer beams, should be four inches from the outside face, no matter whether the flues are smoke or air ducts. The header to an open fire-place is of course much further from the chimney. On the lower side of the header of a fire-place is nailed a strip of wood, and from this strip on the header to the chimney wall a brick arch four inches thick is turned, which is called the trimmer or hearth arch, the upper surface of which, when leveled with concrete, receives the hearth-stone. The smoke-flues of furnaces, steam boilers, bakers' ovens, large cooking ranges, laundry stoves, and of all fires of similar capacity, ought to have sides at least eight inches thick, unless there is a fire-clay pipe-lining inside, leaving an air-space, when the thickness of the flue may be four inches.

Flues with thin walls lose their heat more rapidly than those with thick walls, and consequently the

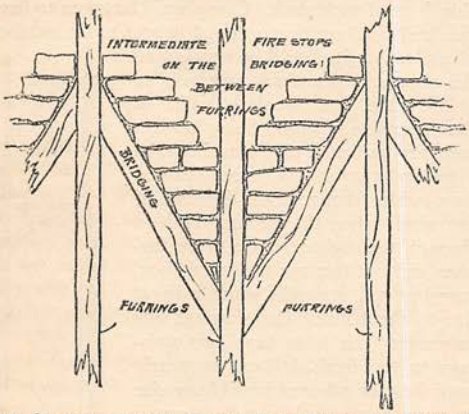

FIG. 6.—INTERMEDIATE FIRE-STOPS OF BRICK AND MORTAR.

draught is not so good. In building the chimney above the roof, care should be taken that the joints are made thoroughly waterproof with cement mixed with sand. The chimney should always be carried up at least three feet above the roof, and should never be constructed with a foot or base immediately above the opening in the roof, as the chimney is certain to settle, in which event the upper portion would be caught on the rafters, and the lower part, sinking away, would leave a dangerous opening. Irregular chimneys can be better bonded, are much stronger, and therefore resist wind-action better than those of the common form. It is a very common thing to see chimneys leaning out of the perpendicular, and they will generally be found to lean from the direction of the prevailing winds. Irregular chimneys are more stable, and they give opportunity for picturesque grouping. Chimney flues are sometimes built four by sixteen inches, inside measurement, but while the area is the same as a square flue eight by eight inches, the latter gives a better draught, and a circular shaft is better than either. If the flues are carried up nearly straight, and without being twisted, eight by eight inches is enough

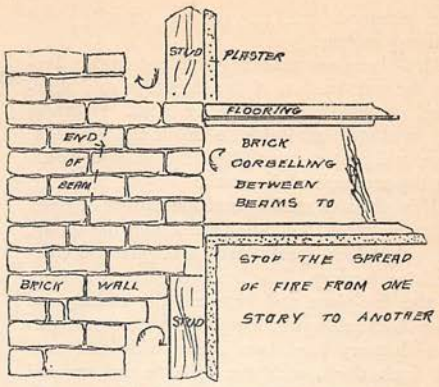

FIG. 5.—BRICK CORBELING BETWEEN BEAMS.

for any stove, or for an ordinary hot-air furnace or a medium-sized open fire-place; the danger of obstruction is so great, however, that prudence dictates flues eight by twelve inches, where practicable. It is necessary to be watchful during the construction of flues to make sure they are smooth and uniform in size.

The chimney partitions between the flues should be well bonded by being roughly mitered with the outside walls of the chimney. If this is not done the partition is formed of a series of superimposed bricks, depending on the feeble adhesion of the mortar for their support, so that not infrequently the partition loses its balance, and leans one way or the other, thus stopping up the adjoining flue. Hoop-iron or tin ties are sometimes used to sustain the partitions, but the mitered joint is better, especially in high chimneys, where a thorough interlocking of the partitions with the walls adds materially to the strength of the shaft. The inside of the flues is frequently plastered with mortar, producing a smooth inside surface, but the plastering may drop down and take with it the joints, and thus open a passage for sparks. Owing to the carelessness, and oftentimes criminal incompetency, of workmen, this practice is forbidden in some localities. Sometimes a plastering of one part lime to three parts fresh cow manure has been used with great success, owing to the polished sur-

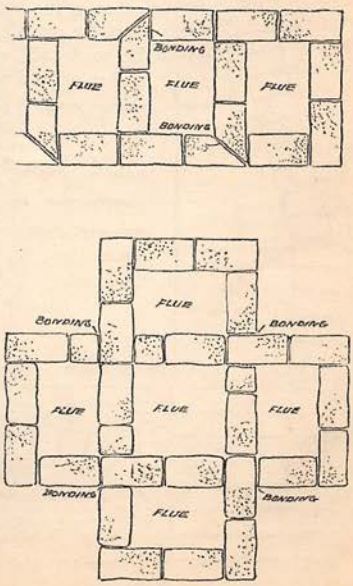

FIG. 7.—PROPER METHOD OF BONDING CHIMNEYS.

face obtained and its greater tenacity over ordinary mortar.

Fire-places are generally built up roughly during the construction of the chimneys, and afterward lined with soapstone or brick. If bricks are used it is advisable to finish the whole at once, and protect it with boards from injury during the progress of the work.

This obviates settling and the danger of open joints between the rough work and the lining, through which sparks may reach the space behind the furrings. The brick-work arch in front of the fire-place and between the ceiling and floor should always be supported on two wrought-iron chimney bars, two inches wide and one-half inch thick, with the ends turned up and down in the piers. Dependence should never be placed wholly on arches over the openings, as these are liable to open, while the wooden centering on which the arch rests while it is building is often left to communicate fire instead of being removed when the arches have set. This is due to thoughtlessness on the part of masons. A four-inch recess in the fire-place often suffices for small hard-coal grates, as the grates project three or four inches from the wall. These work well if the draught is good, but a recess eight inches deep is better, and for wood or soft coal a recess of twelve inches is necessary.

On the placing and construction of heaters depends much of the safety of buildings. The sides and top of brick hot-air furnaces should be kept four inches from any ceilings, floor beams, girders, or wooden partitions of any kind. When the cold air enters at the top of the furnace, and passes over the top of the hot-air chamber, the outside cover ought to be of brick, iron, or tin plate, supported by iron bars, and made perfectly tight. This cover is in addition to and six inches from the cover of the hot-air chamber. When the cold air enters at the bottom of the furnace the outside cover ought to be made of bricks, with two inches of sand on the top. This cover should be four inches from the hot-air chamber cover, which ought to be either a brick arch or two courses of brick supported on iron bars. The walls of the furnace ought to be built hollow, each wall four inches thick, with a four-inch air-space. The walls of a flue or shaft leading from the hot-air chamber, and supporting a register, should be eight inches thick, unless there is a metal pipe inside, when four inches will do. The floor beams should be kept four inches from the outside faces of such shaft. Care should be taken to have the fresh-air box proportioned in area to the number of outlets, or it should be equal to all the register pipes which may be open at one time, less one-sixth, which is the expansion of air on being heated; and very particular care must be taken to prevent a reversal of currents caused by a sudden change in the direction of the wind, when the air may rush in through the register, down to the furnace and out through the supply box, carrying with it sparks which may set fire to the house. The simplest way to prevent this is to have two openings to the fresh-air box, as nearly opposite each other as possible, or else to carry the supply box entirely across the building, at a little distance from the furnace, and connecting with the furnace by a short pipe. Then the wind may blow at will through the main pipe, as the small one alone supplies the necessary amount of air directly to the furnace. The supply box may be made either of wood or metal. Galvanized iron is the best material that can be used, but if it is made of wood the first three feet of the box nearest the furnace must be of iron or brick. Portable hot-air furnaces should be kept two feet from plastered partitions or ceilings, unless they are protected by a bright tin shield, when the distance may be one foot. A stone slab, or a course of bricks well laid in mortar and extending two feet in front of the ash-pan, ought to be placed under each portable furnace to protect a wooden floor.

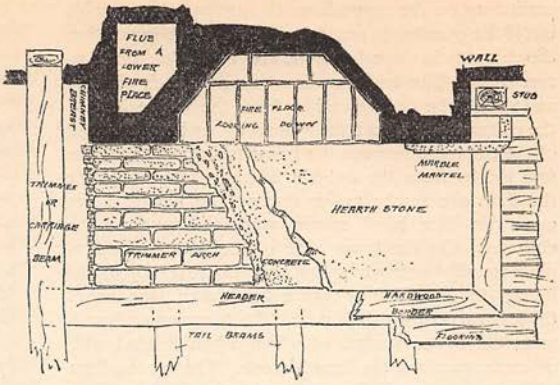

FIG. 9.—HORIZONTAL SECTION OF FIRE-PLACE.

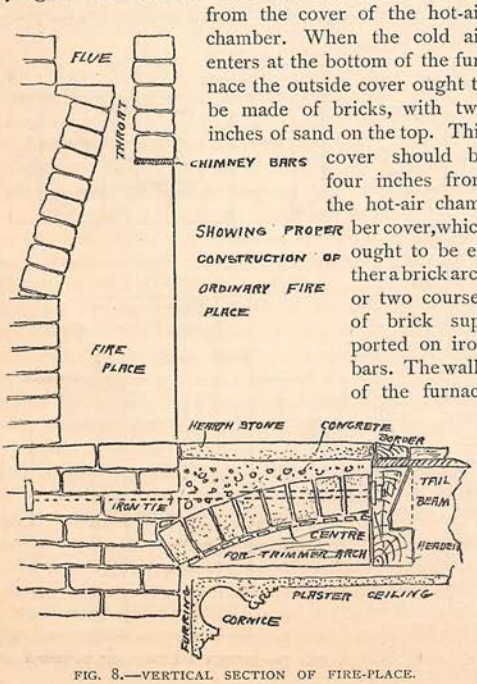

FIG. 8.—VERTICAL SECTION OF FIRE-PLACE.

FIG. 10.—HOT-AIR FLUE OR DUCT IN PLASTERED PARTITION.

Smoke-pipes ought never to pass through the floors of a building. Stove-pipes should never be nearer than twelve inches to any ceiling or partition which can burn, unless a metal shield intervenes, when half

that distance will suffice. If it is necessary to carry stove-pipes through wooden partitions, double metal collars, three inches apart, pierced for ventilation, ought to be used, or soapstone rings three inches thick, or earthen rings two inches from the pipe, and extending through the partition. Where the products of combustion at high temperatures are disposed of, the distances from wood-work and for ventilation naturally require enlargement.

All hot-air pipes or registers should have at least four inches of solid masonry, whether of brick or stone, for outside casing, and if it is necessary to build such pipes in wooden partitions, a second and outside pipe ought to be placed around the hot-air duct, at least one-half inch distant, and this outside pipe should be three inches from the studding on each side, and the studding should be protected by tin-plate lining, while the spaces from one piece of studding to the next, and across the hot-air pipe, ought to be covered with wire-lath and plaster or slate. The partition, moreover, should be eight feet distant, in a horizontal direction, from the furnace, and if the partition is not on the same floor as the furnace, a plumb-line dropped from it should be the same distance from the furnace.

A small additional expense in using wire-lath throughout a house adds greatly to the security against fire. Besides, the powerful clinch or hold the mortar takes on the wire-lath prevents any force from detaching the plastering, which will not crack or sag. No violence can shake it down, while continued water-soaking will not detach it from ceilings.

For perfect safety, horizontal hot-air pipes should be at least six inches from the ceiling, unless protected by metal shields, when they may approach to three inches. And if they pass through stud partitions the collars previously mentioned should be employed. Under no considerations should hot-air pipes be allowed between any combustible floor and ceiling. Hot-air registers should be protected by soap-stone borders firmly set in plaster-of-Paris or gauged mortar. All register boxes should be of tin-plate, with a flange on top to fit the groove in the soapstone, upon which the register rests; there should be an open space of two inches on all sides of the register box, extending from the under side of the soapstone and through the ceiling below. This opening should be fitted with a tight tin casing turned under the soapstone, and having the lower end at the ceiling open. When a register in the floor is over a furnace, the open space should be three inches, and if this register is the only one connected with the furnace there should be no register valve with which careless persons could tamper.

Steam-pipes should never approach wood-work nearer than two inches, unless protected by a metal shield, when one inch is the limit. Covers to recesses in walls of brick or stone should be of metal, and these recesses should not be in depth more than a fourth part of the thickness of the wall, and all recesses should be built up solid at the floors.

Gas brackets should be kept at least three feet from any combustible ceiling or wood-work, unless a metal shield one-third the distance down intervenes, when half the distance will answer. All lights near window-curtains or any other combustible material should be protected by glass globes or suitable wire screens.

George Martin Huss.

THE WORLD'S WORK.

Ship Ventilation.

PASSENGERS upon ocean steam-ships who occupy state-rooms placed below the spar deck frequently resort to temporary wind-sails to secure a supply of fresh air in their rooms. While the steamer is in motion the leeward rooms cannot be ventilated thoroughly by merely opening the ports. The air passing the smooth sides of the ship does not affect the atmosphere in the rooms, and it remains comparatively quiet. The same thing happens in all the rooms in a calm, and when the wind is ahead or astern. To direct the fresh air into the room, a piece of sheet-tin or a piece of card-board may be crowded into the side of the port, leaving a part to project outside, in the form of a scoop or ear. This makes a wind-sail to throw a current of air into the room. This familiar device has been made the basis of a ventilating apparatus designed to be permanently fixed to the state-rooms of a ship. It consists of a short telescopic tube passing through the side of the vessel, and opening into the state-room near the ceiling. The movable portion of the tube is cut away on one side and closed at the end, and it may be drawn in or out by means of a handle in the room. When not in use the tube is drawn in level with the side of the ship, and it is then closed water-tight. When in use the tube is pushed out, and as the open part faces the wind (or forward) it acts as a wind-sail, catching the wind and directing it into the room. A floating valve is placed inside the tube to prevent the entrance of water in case the ventilator should be submerged by the rolling of the ship. The only criticism that can be made of the apparatus is that, while the idea is a good one, the apparatus itself is heavy and clumsy, and badly designed. Better appliances upon the same system will no doubt soon be introduced.

The idea of using the rolling motion of a ship as a means of ventilating vessels was made the subject of experiments some years ago, that were described at the time in this department. A simple and comparatively inexpensive apparatus based on this idea has now been introduced upon a number of steam-ships. On the main deck, near the middle of the ship and close to the sides, are placed two upright iron cylinders, resembling common upright steam-boilers. The two cylinders or