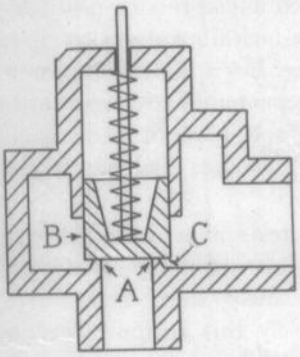
Back Pressure Opens Safety Valve on Idle Boiler

TWO men were at work some time ago in front of the open tube cleanout doors of an idle horizontal water tube boiler when suddenly the safety valve on a companion boiler popped and, much to the men's surprise, a cloud of steam was discharged from the empty boiler into their faces. They were puzzled, for the stop valve and blow-off valve were tightly closed and they could think of no way in which steam could have entered the empty boiler.



When an inspector next visited the plant they told him of the occurrence and he undertook to find the explanation. The boiler was one of several used to heat a large store building and the safety valves on all boilers were piped to a common line that ran a long distance before opening to the atmosphere. From the unusual length and layout of this line the inspector reasoned that friction would build up an appreciable amount of back pressure while a safety valve was popping, and it occurred to him that there might be something about the safety valve on the boiler in question that caused it to open when pressure was applied to it from the discharge side.

On examining the valve the inspector found that it was of the type shown *diagrammatically* in the sketch. Plunger "B" had no exposed area on which back pressure would act downward to help the spring hold the valve closed. However, it extended a considerable distance beyond the seat "A" so that there was an area "C" on which back pressure could act upward, thus tending to open the valve. For this particular valve the overlapping area was considerably larger than the area exposed to boiler pressure, so a back pressure even less than the rated popping pressure of the valve was sufficient to lift the plunger.

The discharge line was not only long but it had a sharp bend in it. Probably what happened was the safety valves on two boilers popped simultaneously and caused a momentary back pressure that was enough to raise the plunger of the safety valve on the idle boiler.

When a safety valve discharge line is reasonably short, straight, and of an area at least equal to the combined discharge areas of the valves connected into it, there should be very little or no back pressure. With such an installation there would seem to be very little possibility of any type of safety valve opening under back pressure unless, of course, the

discharge line should become stopped up in some way. The incident is cited merely to call attention to the importance of having safety valve discharge lines so arranged that they offer as little resistance as possible to the outflowing steam.

Several Recent Explosions of Heating Equipment

TWENTY-FOUR guests at a Halloween party in Sidney, Ohio, had narrow escapes from injury when a cast iron heating boiler exploded a few minutes after they had left the home of their hosts, causing damage to the house and furnishings estimated at $22,000. The boiler stood directly beneath the living room in which the guests had been seated. Figure 1 shows the room as it appeared after the

Figure 1

blast. A nursemaid and a baby who were asleep on the second floor were not injured, although ensuing fire threatened to block their escape from the building.

In Johnstown, Pa., a four-year-old girl was fatally scalded on November 7 when a section of a cast iron boiler burst and showered her with steam and hot water while she was at play in the basement of her home.

A cast iron boiler explosion on October 26 under a sales room in Cleveland, Ohio, came near resulting seriously for the proprietor. The telephone had rung and he was walking toward it when the heavy

boiler top came up through the floor, hit the ceiling, and crashed down on the 'phone. The boiler was of the round, vertical type, equipped with a safety valve of ample capacity and in good working order. It was thought that the casting may have been either weak or cracked and that failure occurred at a pressure less than 15 pounds.

Early in December, Alabama street in Indianapolis, Ind., was the scene of two heating equipment explosions on consecutive days. Both accidents occurred in apartment houses and in one, which resulted in

Figure 2

the death of the janitor and the injury of two other men, the janitor was thought to have been working on the boiler when it let go, hurling people from their beds in the apartments and badly wrecking the lower floor of the building. A day after this accident a hot water supply tank exploded in the basement of another apartment house in the same street, tearing a large hole in the floor of the suite directly above it. A woman who was in the apartment suffered from shock. It was reported that there had been repair work done on the tank a few days before the accident.

Just before daylight on the morning of December 30, persons living in a residential neighborhood in Camden, N. J., were rudely awakened

as an exploding hot water tank wrecked the interior of an expensive home. The concussion was so severe that the occupants of a neighboring house were thrown from their beds. In the house in which the explosion occurred walls were cracked, floors were bulged, and the windows as well as doors were torn from their fastenings. Property damage was estimated at $7,500.

Figure 3

Another recent explosion occurred on New Year's Day at a residence in Worcester, Mass., where a hot water supply tank shot up through two floors to the roof. Figure 2 shows the hole in the roof where the tank struck, as well as a bulged side wall, but it does not give an adequate idea of the damage to the framework and interior. As in the case previously described, the lower floor of the house was wrecked. Furniture was tumbled about, plaster was shaken down, gas pipes and electric light fixtures were broken, and radiators were wrenched from their fastenings. Because heavy floor beams were broken and the whole framework was seriously impaired, the owner was of the opinion that the house would have to be virtually rebuilt.

The tenants were not at home when the accident occurred. It appeared that some one had accidentally left the gas coil heater burning.

Figure 3 is a view of a room of the McKinley school in Willobee, Ohio, where the explosion of a hot water tank during the Christmas recess caused property damage estimated at $15,000. Only one man, an electrician, was in the building at the time. He was fortunate in escaping injury as he was working in a narrow space between the roof and the ceiling of the room here shown. He was obliged to dig his way out after the explosion hurled debris over the trap-door exit. Had the explosion occurred a few hours later many lives would have been endangered, for that evening the school team was to have played a basketball game in the building.

The tank was of lap-welded construction, about 30 inches in diameter and four feet in length. It was protected by a safety valve supposedly set to relieve at a pressure of 60 pounds per square inch. Failure occurred by the blowing out of the minus head which tore through the base of a 90-foot brick smokestack and brought it down. The tank itself was driven endwise through a wall, the shock being sufficient to collapse the roof and damage one class room, the assembly hall, and the cafeteria.

When examined after the accident, the safety valve was found to have had its spring screwed down so far that the coils were nearly squeezed together. Under test, the valve dripped slightly at a pressure of 135 pounds and opened as wide as the compressed spring would permit at 145 pounds.

The closing of the inlet and outlet valves of a cast iron water heater on which there was no relief valve caused the heater to explode on December 31 and kill the superintendent of an apartment house in Brooklyn. Apparently the water heating system depended for protection against overpressure on the fact that a rise in pressure would back water out into the main through the feed line connected to the tank. When the heater was segregated from the tank by closing of the stop valves it was deprived of this protection. Like a tightly stoppered bottle of water placed over a fire, it burst as soon as the pressure within it became greater than it could withstand.

To the best of our knowledge, there was no boiler insurance in effect on any of the accidents here described.

Another Oxide of Carbon

CARBON dioxide, CO_2, the product of the complete combustion of carbon, is an inert gas which has long been familiar to mankind in the foam of beer, the sparkle of champagne, and as the driving force of the soda siphon. More recently in its solidified form of "Dry Ice" it has extended its range of usefulness.

Carbon monoxide, CO, which results from incomplete combustion of carbon, serves us well as a major constituent of ordinary illuminating gas and serves us badly in the exhaust gases of motor vehicles, which it renders highly poisonous by its habit of combining with the red coloring matter of the blood, which thereupon loses its power of uniting with oxygen in the lungs.

Familiar as both of these oxides of carbon are to everyone, we now have to reckon with a third, the suboxide of carbon, C_3O_2, with which only a few chemists have as yet even a speaking acquaintance.

The suboxide is a gas at ordinary temperatures, but is easily condensed to a liquid boiling at 7 degrees Centigrade and to a solid which melts at about 110 degrees below zero, centigrade. It has an unbearable odor, like mustard oil; its dilute vapor brings copious tears. In greater concentration it attacks the whole respiratory system with suffocating effect. It burns in air to CO_2, and with water it forms malonic acid. With ammonia, aniline, and many other chemicals it units to form a variety of compounds. Heated, it polymerizes to a dark red solid. Like many other laboratory curiosities it may one day find its place in industry.

These oxides of carbon afford a striking illustration of the extraordinary difference in properties which compounds of the same two elements exhibit as the proportions of the two constituents vary. We have another example in the case of water, H_2O, and hydrogen peroxide, H_2O_2. *(Industrial Bulletin of Arthur D. Little, Inc.)*

Hot Water Heating System Boilers Explode

THE first two recent accidents to heating equipment about to be described involved boilers used for heating buildings by means of the hot water system. Particular mention is made of this because it is by no means unusual to find owners of such heating systems of the opinion that their boilers are not of the exploding kind.

Figure 1

The proprietor of a candy shop in Audubon, N. J., was serving a customer a cup of hot chocolate on the afternoon of March 9 when the hot water system heating boiler exploded and hurled both men through a window into the street. Fortunately, the plate glass preceded them by a fraction of a second, so they escaped with minor bruises and cuts. Figure 1 shows the rear of the store. The back wall of concrete blocks was hurled down, and the side wall was tilted outward so as to be in danger of collapse. A newspaper account stated that the property damage amounted to about $5,000.

Reports indicate that the system was installed without either an expansion tank or a relief valve. Coke was being used as fuel, and as the day was cold and windy it was suspected that the vigorous firing necessary to meet these conditions was too much for the boiler.

Figure 2 shows what was left of the firepot section of a hot water heating boiler that exploded on March 11 in the basement of a pumping plant in Haverhill, Mass. This, too, was a closed system, but one having an air-tight expansion tank and a differential relief valve. The top and third sections of the boiler crashed upward through the first floor, forcing a 12″ x 6″ beam out of its anchorage in the brickwork, and raising the whole first floor up about three inches. Other parts of the boiler caused considerable damage to the plant switchboard, bending

Figure 2

switch handles, breaking a slate panel, and piercing an iron grill protecting the oil switch. The steel-trussed roof of the building was also raised by the concussion. One of the trusses pulled the brick side-wall about four inches out of perpendicular at the resting place of the truss.

During the morning the attendant noticed that the return pipes and about one-third the height of the radiators were cold. He supposed that the system was air-bound, so he tried the pet cocks on the radiators and drew a small amount of water from the system before admitting sufficient makeup water to bring the gauge up to the normal pressure of about 8 pounds. He noted then that the thermometer on the boiler read 140°F. Twenty minutes after he had thrown on a little coal and

left the building the explosion occurred.

Neither the relief valve nor the expansion tank was damaged by the explosion. When tested, the valve worked freely at 25 pounds. The cause of the accident could not be positively determined. In view of the fact that boiler had been used previously at another location—and possibly under conditions that may have affected the strength of the castings—failure might have occurred under normal operating conditions. If the water had been brought to the boiling temperature corre-

Figure 3

sponding to eight pounds pressure there would have been sufficient energy stored in the boiler to account for the damage done by its failure. If such was the case the safety valve, set to blow at 25 pounds, would not have had any opportunity to act.

The last of several employes of a garage in Peoria, Illinois, had just left the locker room shown in Figure 3, on the morning of January 18, when a small cast iron boiler used for supplying hot water, exploded, smashed furniture, knocked out windows and doors, and raised the ceiling. The men had just changed to their work clothes, preparatory to beginning the day's work. Had the explosion occurred while

they were in the room it is probable that some at least would have been seriously injured. This heater was not equipped with any means for relieving overpressure, nor was there a device for temperature control.

In Figure 4 is shown the wreckage of a welded steel hot water supply boiler that exploded January 28, in a building at Yakima, Washington. This boiler was connected to a welded hot water supply tank and neither boiler nor tank was equipped with a relief valve. The day

Figure 4

before the accident the water was shut off from the main in the street. The following morning the engineer fired up the boiler and the explosion occurred three-quarters of an hour later, causing property damage estimated at $2,000.

Another accident from a similar cause occurred in a store at Long Beach, California, on January 14. In this case the apparatus involved was a hot water supply tank heated by a gas coil. The system had been out of use for some time and when starting it up someone evidently forgot to open a valve in the line from the tank to the water main. The tank had no relief valve, depending on free communication with the outside water main for relief of overpressure. With a closed valve cutting off this means of relief, the tank wrecked the store and damaged apartments above it. The property loss was estimated at $3,000.

The occupant of a residence in Clinton, Iowa, felt that he escaped death by seconds on the morning of March 21 when, as he was walk-

ing down the cellar stairs to tend the furnace, the latter exploded and tore a hole in the floor above it. He had been down in the basement to open the drafts about fifteen minutes before, and was going again to check the fire.

Hydro-Pneumatic Tank Explodes in Garage

PATRONS and employes of a car washing laundry in a North Carolina city were fortunate to escape serious injury on December 9 when a hydro-pneumatic tank blew out its lower head, soared upward and came down through the roof of an auto show room 100 feet away. Luckily the show room was unoccupied at the time, for the heavy vessel brought down plaster and splintered timbers as it crashed on the concrete floor.

The tank was of the kind commonly found in car washing garages for furnishing water under pressure. Although this particular tank was used under a pressure of 150 pounds, it is interesting to note that it was made of tank steel, only ⅛" thick. It stood 6' 4" high and was 30" in diameter. The longitudinal seam was lap riveted with fusion welding on the outside, evidently to make it air tight. Heads were of quarter-inch material, the top one being convex and the bottom one concave. In fastening them in, the ends of the shell plate had been crimped over slightly and a thin strip of fusion welding applied between these ends and the heads.

Installed in 1925, the tank was in operation for several years under 150 pounds pressure. A few months ago the unloader on the compressor became out of order and prevented the pressure from rising above 90 pounds. According to attendants, the pressure gauge registered 80 pounds just before the explosion took place.

The lower, concave head reversed its dish when the explosion occurred, tore away from the shell at the weld, and remained behind while the vessel, propelled by the reaction of escaping air, rose like a rocket. Of the several persons who were standing near the tank only one was knocked down and injured.

These hydro-pneumatic tanks, of which thousands are in use, contain enough energy to do tremendous damage in case of an explosion. Needless to say, the prospective purchaser should be careful to select a vessel of approved design and construction. The need for care is even more important where welding instead of riveting is used, for it is next to impossible to tell by looking at a welded seam whether it is sound or not.

The compressed air equipment of garages and service stations con-

tributes its full share of accidents. In addition to the case just described, there was recently an explosion of a compressed air tank in an Indiana city that tore down two walls of a filling station. The damaged building and tank are shown in the accompanying illustration, which is from a photograph taken after the wreckage had been cleared away. In this case the accident was evidently not caused by any structural weakness of the tank. According to reports, someone screwed down the spring of the safety valve so that it permitted overpressure to develop.

Some Violent Heating Equipment Accidents

SOME recent and disastrous accidents, both to heating and to hot water supply systems, indicate the importance of their being installed with adequate automatic safety devices for relieving excess pressure and for accurately regulating the fuel supply. The presence of such devices, however, is only half the story. To be sure that they operate correctly, they should be checked carefully and regularly by someone trained to recognize their tricks and their peculiarities.

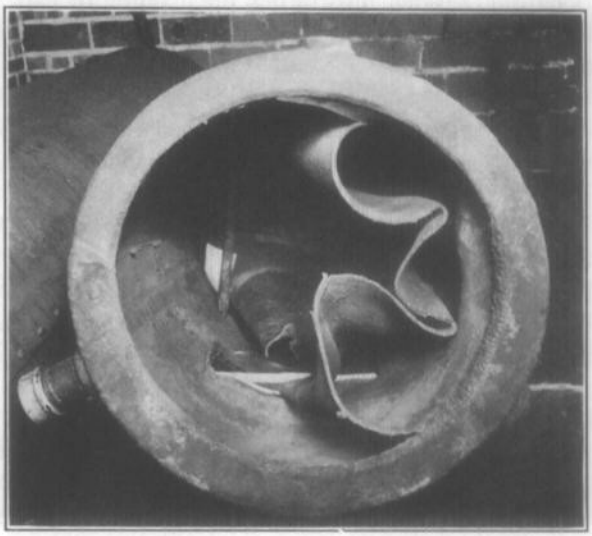
Hurled across the boiler room by the concussion when a round steel heating boiler exploded in the basement of a garage and tire and battery shop, one man was so badly injured that he died a few minutes after a police ambulance had rushed him to a hospital. He had just entered the room when the explosion occurred, according to the boiler room attendant who, himself, escaped injury by the narrowest of margins. The blast broke water pipes, cracked the concrete floor above the boiler, shattered windows, and so choked the basement with steam that attendants several times were forced back from the entrance to the boiler room before they were able to reach the injured man.

All seams of the boiler were welded. As can be seen in the illustration, the inner shell tore away from the base ring around practically two-thirds of its circumference. The safety valve was not found, so it is a matter of conjecture whether the initial cause of the inner shell's collapse was failure of the welded seam or overpressure within the boiler.

The explosion of a forty gallon copper hot water supply tank in a fine residence caused nearly $5,000.00 damage to the house and furnishings. Five members of the family and the maid, who were asleep in the upper rooms, fortunately escaped injury, although the rear wall of the house was torn away, one wall of a sunparlor at the front of the house blown down, and plaster and debris from falling partitions scattered all over the first floor.

Evidently the gas-fired coil heater had not been turned off when the family retired. It is thought that the system lacked adequate relief equipment, for pressure accumulated inside the tank, increasing until at last the copper shell tore apart. Bottom head and base were driven through the kitchen floor into the basement; shell and upper head shot up into the ceiling, hit a steel beam, and were deflected out through the side of the house, taking window frames along too. Had its course not been turned from straight upward, injury might have struck those asleep upstairs.

Trouble with the thermostatic regulation of gas-flow in relation to water temperature, and failure of the relief valve to function at a reasonable pressure, probably were responsible for the violent explosion of a steel hot water supply tank in an undertaking establishment. The tank was of the storage type, with an integral heating unit below it. All seams were fusion welded, the longitudinal seam a lap joint, fillet-welded on the outside only. The heads, both of plus design, also were fillet welded.



During the week prior to the accident, the thermostatic control, supposed to regulate the flow of gas according to the temperature of the water, had not been working properly. The proprietor noticed that occasionally the flame was unusually high and the water unusually hot. After an unsuccessful attempt to regulate the thermostat, he shut off the burner and called the local gas company. Adjustments were made, but the trouble must have persisted, for two days later the tank exploded. Although every seam was torn apart, it is thought that overpressure, resulting from the non-functioning of safety devices, was to blame, rather than possible weakness of the welds, which seemed to be of good quality.

The boiler room was closed off from the rest of the basement by an eight inch concrete wall on three sides, the elevator shaft forming the fourth. The three walls were completely demolished and one side of the elevator shaft blown in. Part of the enclosure surrounding a pipe organ was destroyed and the organ badly damaged. The force of the blast broke windows, set doors out of line, and moved the sectional cast iron heating boiler sideways about ten inches, cracking its base and breaking down piping. The total extent of property damage was estimated at $4,000.00.

Steam Heating Boilers in Violent Explosions

THE account we have received of the heating boiler explosion pictured below, indicates that the safety valve was either inoperative or else it was not large enough to relieve pressure that increased rapidly when an attendant closed the stop valves in both the steam and return lines. This accident occurred on December 2 at the

showroom of a large automobile agency, and although several automobiles on the showroom floor were badly damaged—two of them falling into the hole shown in the picture—only one person was injured. That happened to be a passerby who stopped to look at the display of cars and was cut by pieces blown from the plate glass window.

Two coal fired cast iron sectional boilers comprise the batttery used for heating the showroom. During extremely cold weather both boilers are used at a pressure of from five to ten pounds, but at the time of the accident the weather was unusually mild and only one boiler was in use.

Because of the warmth, the agency manager had instructed the boiler operator to fire less vigorously, so it seems not unlikely that the operator closed the stop valves with the idea of making the build-

ing more comfortable by temporarily shutting off the supply of steam.

The boiler was hurled about twelve feet from its setting and driven through a stout brick fire wall. The damage was estimated at $10,000.00. As far as is known, there was no boiler insurance in effect.

The heating plant in the parish house of a church in Nanticoke, Pennsylvania, had been giving trouble for some time. According to the pastor, it would not keep the building warm. From his description of the difficulty, investigators of the boiler explosion which occurred there on November 19 were led to believe that the accident was caused by some fault that prevented the free return of the condensate to the boiler. As the latter appears to have been overheated, their supposition was that the condensate was held back in the system and that, eventually rushing into the boiler, it caused overheated sections to crack.

The explosion blew out doors and windows in the basement and broke a hole six feet square in the parlor floor above.

We cite below a few of the explosions that occurred during a week in December to heating boilers in buildings other than residences. The information has come to us in the form of newspaper clippings, only, and we do not know whether or not there was any insurance in effect. However, they were not insured in the "Hartford Steam Boiler", and it is probable that the owners had no such protection.

The explosion of a heating boiler on December 11 at a theatre in Oak Park, California, occurred with such severity that it shook loose from its hangings the large entrance covering over the sidewalk in front of the building.

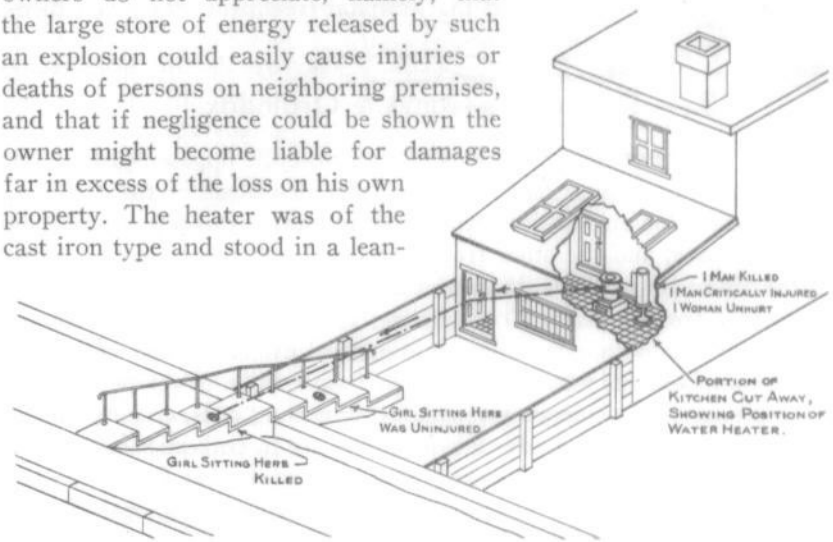
At Onancock, Virginia, a piece of iron blown from a heating boiler in the high school narrowly missed striking a man. The classroom above the boiler was badly damaged. This accident occurred on December 12.

A heating boiler in the garage and office of a Philadelphia motor sales organization exploded on December 17 and, according to the newspaper account, "terrified thousands of persons in the busy neighborhood". The building was shaken and goods stored in the basement were damaged.

Until a temporary heating boiler could be installed, it was necessary for a printing plant in Battle Creek, Michigan, to shut down after an explosion of its boiler on December 12.

Water Heater Explosions Claim Several Lives

THE fatal explosion of a water heater in a residence at Conshohocken, Penna., early in October differed very little in essential detail from the many accidents to similar equipment that are constantly coming to our attention. However, in killing a young girl who was some distance from the boiler, it brought up a point that most home owners do not appreciate, namely, that the large store of energy released by such an explosion could easily cause injuries or deaths of persons on neighboring premises, and that if negligence could be shown the owner might become liable for damages far in excess of the loss on his own property. The heater was of the cast iron type and stood in a lean-



to kitchen at the rear of the home. Of the three persons who were in the room when the explosion occurred, one man was fatally injured, and another was injured so badly that for a time his condition was critical. One of two small girls playing in the back yard, as shown in the sketch, was struck in the head by a fifteen pound piece of iron. She died at the hospital within a few hours.

Municipal authorities attributed the accident to stoppage of pipes by corrosion and sediment. In the absence of a safety valve this blocking of the circulation could have permitted overpressure that could not be relieved by the backing out of hot water into the city mains.

Another accident to a water heater of about the same type occurred on November 4 at a garage in Denver, Colorado. In this case the heater was being used to furnish hot water for washing cars, and was so installed that there was no means for relieving overpressure. There was no relief valve, and a check valve in the feed line effectively prevented the relief that might have been obtained through direct communication with the city water main.

This accident occurred during the noon hour when no water was being drawn from the system. All indications pointed to overpressure as the cause. The exploding heater injured a garage workman seriously and wrecked the interior of the room in which it was located, shattering itself into pieces no larger than a man's hand.

In Philadelphia, on the night of November 14, a two year old child was killed by the explosion of a small cast iron water heater. Three other persons were so injured that hospital treatment was given them.

Accidents to Heating and Hot Water Supply Equipment

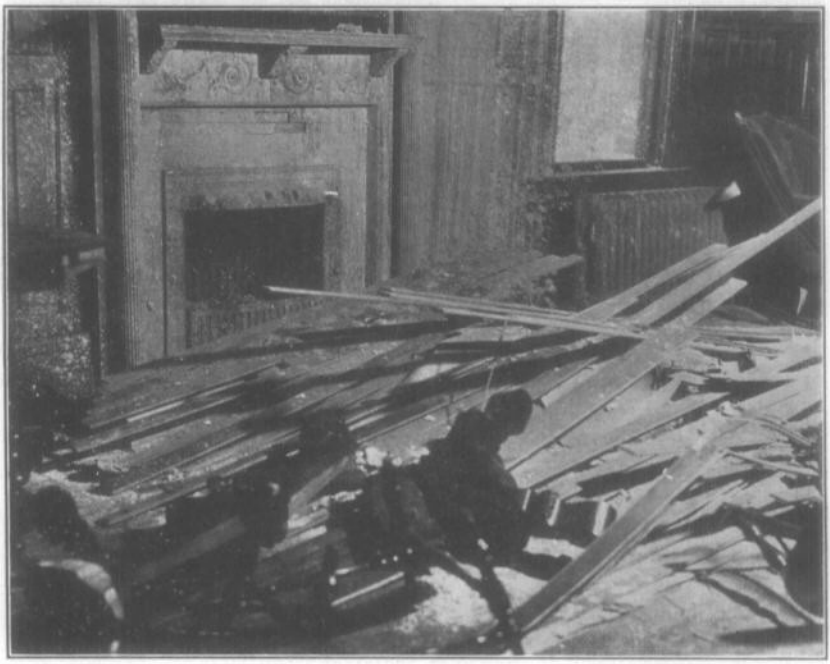
THE executive mansion of West Virginia, a Baptist parsonage and homes, apartments, stores and manufacturing buildings in widely separated parts of the country were damaged in recent months by accidents to heating boilers and hot water tanks and heaters. Fatalities resulted in two explosions and in most of the accidents persons were injured.

When water froze in both the supply and return lines of a small cast iron boiler and a fire was started, the resultant overpressure caused an explosion which killed two men, hurt five others and caused serious property damage. The boiler was used at a Berkeley Heights, New Jersey, brickyard to reduce the viscosity of fuel oil for power boilers operated on the premises. Normally the boiler carried no more than five pounds pressure, but the freezing of the water in the pipes made it a closed vessel.

Freezing pipes also were given as the cause of an explosion in a

bottling plant in Cincinnati which injured two men and resulted in some $2,500 property damage. The boiler was being fired up when the accident occurred.

A furnace gas explosion in the basement of Governor William G. Conley's executive mansion at Charleston, West Virginia, nearly resulted in the death of West Virginia's first citizen. Becoming chilly on a Sunday night and knowing that servants were away he went personally to the basement to determine why the gas burner in the furnace was not functioning. Cautiously he opened the furnace door with a stick and an



explosion of terrific violence occurred almost immediately. Governor Conley was burned about the face, but he was able to shut off the gas and avert further trouble. The cause of the accident was attributed to ignition of the gas and air in the furnace by a pilot of a nearby hot water heater. Damage to the mansion was estimated at $1,000.

Rev. William W. Barker of Woonsocket, Rhode Island, was in the kitchen of the parsonage early on a Sunday morning in December when an explosion shook the house, broke windows, upset furniture and damaged valuable antiques. The living room was a mass of debris (see illustration) and the house was jarred from its foundation. A heating boiler

had exploded and the top section had crashed through a 12-inch beam. It was reported a non-operating safety valve had led to the explosion. The pastor, his wife and a roomer all escaped injury.

An oil fired, fusion welded hot water heater, used in a New Orleans apartment house, exploded early in February, reduced the basement to a mass of debris and seriously scalded the attendant.

A combination of hot coals from a nearby boiler, "green" soft coal and a closed damper is believed to have caused the furnace explosion which destroyed the hot water heater in a Dorchester, Massachusetts, apartment. No one was injured, but tenants were inconvenienced because of gas, vapor and smoke in the hallways.

Investigation of an explosion in an automobile sales building in Philadelphia brought reports of clogged supply lines, which, coupled with the fact that there were no safety appliances or devices, resulted in an explosion due to over-pressure. Because the boiler was in a confined room in the basement the explosion did little damage.

Lack of relief valves and an improperly welded repair were factors in the explosion of a barber shop towel heater in East Providence, Rhode Island. As the explosion occurred after the shop had closed for the day, loss was confined to property damage.

Other explosions brought tragedy to families. Near Greenville, Texas, a woman died of injuries and a 2-year-old boy suffered a broken ear drum when a water heater burst. At St. Louis a man and his wife were badly scalded when their boiler exploded as they were standing near it. Pipes connected to a water tank in a stove at Rock Hill, Illinois, froze, causing the tank to burst, and scald a mother and her two children who were in the kitchen. An exploding hot water tank in a residence at Danielson, Connecticut, tore loose one side of the house, bulged another side and loosened the foundation in several places. The burner had been lighted and not turned out when the family retired. At 2 a. m. the tank exploded. It was reported there was no relief valve. An accident at a hotel in Riverside, New Jersey, caused property damage when an attendant shut the valve between the heating unit and a storage tank when he thought he was opening the valve.

"Open" Tank Explodes

An explosion in a tank which normally was open to the atmosphere illustrates how accidents can occur sometimes to vessels that are supposedly free from the hazard of overpressure. At Omaha, Nebraska, a welded steam tank with heads described as "very flat" was being used as a receiver for traps from parts of a steam system. It left its moorings when the vent of the tank became clogged, permitting pressure to build up and causing a head to fail. There was no safety valve. The tank was 24" in diameter, 48" long and 3/16" thick.

Machinery Lowered by Ice Blocks

The new freezing vat at the Mueller Ice Company, Commerce, Texas, is in position after an interesting engineering feat. The vat came from the factory in steel sheets with rivet holes accurately punched, and was fabricated on cribbing about 18″ above the foundation on which it was to rest.

The finished tank weighed approximately 16,000 pounds, and the problem confronting the engineers was to take out the supporting blocks and lower the tank without straining the riveted seams in such a way that leakage would ensue. To meet the difficulty 1,200 pounds of ice was purchased and sawed into 100-pound blocks. After the blocks were placed under the eight tons of metal, the wooden cribbing was removed, and as the ice melted the tank settled gently into position.

—*Ice and Refrigeration.*

Japs From the Old Chief's Hammer

THE OLD CHIEF inspector sat musing after the close of business over a late afternoon issue of his favorite newspaper.

"Tom," he said to his assistant who had just finished writing a report, "here is another article about a plant which has been ordered by the State to stop dumping its waste into the river. The fish and game conservationists seem to be unusually active. Incidentally their work is sometimes a boon to boiler users."

"How's that, Chief?" Tom Preble asked.

"Didn't I ever tell you about what we ran into a few years ago in searching for the cause of corrosion in the boilers of the big utility plant up the river?"

"I don't believe so, Chief."

The older man's face lighted up, he got his pipe going, and was off on one of his favorite hobbies, the telling of true stories from his wide experience.

"While Inspector Corbin was making his regular inspection visit to the big plant," the Old Chief began, "he noticed that grooving was developing in the upper drums of several boilers, and in addition there was pitting in both the shell plates and tubes. He was surprised, for the condition had developed since his last visit, and had all the earmarks of some sort of corrosive action. The thing was puzzling, though, because as far as he knew there had been no change in a feed water treatment that had been apparently satisfactory in the past. So he mentioned the trouble to the boiler room foreman.

"'I don't understand how that could be,' exclaimed the foreman, after listening to Corbin's description of the symptoms. 'At the rate the grooving is taking place it would most likely mean acid in the water, wouldn't it? Our boiler water always has tested alkaline?' Once inside the drum, however, it took but a glance to convince the foreman that they were up against a condition which, if allowed to continue, would ruin the boilers.

"When they told the plant superintendent, his first reaction was that there must be some mistake. He had been checking the feed water

over a considerable period and in that time the analysis had consistently shown the water to be alkaline. But the signs of corrosion were plainly evident and he was too keen an engineer to waste time arguing the point.

" 'There's certainly something wrong,' he agreed. 'The question is what.'

" 'How often have you folks been analyzing the feed water?" asked Corbin.

" 'Twice a day,' was the reply, 'at 7 a. m. and 6 p. m.'

" 'Even at that,' exclaimed Corbin, 'my hunch is that something in the water is at the root of the trouble. We've got to go into this thing thoroughly and find out, for at the rate the corrosion is developing you folks will have a serious condition on your hands if the cause isn't found and corrected pronto.'

" 'I'm with you up to that point,' smiled the superintendent, 'but in view of the fact that in all our checking of the feed water we've never had any suggestion that it might be acid, I don't quite see what the next step is to be.'

" 'Who does the checking?' Corbin wanted to know.

" 'Our own chemist, right upstairs,' was the answer.

" 'Well then,' said Corbin, 'let's get him to start now making hourly tests. I'm curious to find out what's happening to that feed water during the middle part of the day. If his analysis doesn't give us a clue to what's wrong, I'll want you to send samples taken hourly to our home office laboratory in Hartford. But in the meantime let's see if we can't solve the problem right here.'

"The superintendent agreed to the experiment and called in his chemist while Corbin was there.

"The next morning the plant had me on long distance, wanting Corbin or me or both of us up there right away. They had discovered a strong acidity in the feed water on the 7 p. m. test the night before, an hour after what had been their regular time of testing, and while the 7 a. m. test was alkaline the 8 a. m. results showed the acid condition again. As Corbin was busy in another town, I went to the plant myself.

"There they reported at 9 a. m. a condition of excess acidity. After that the water seemed normal. However, the excess acid present at 8 and 9 a. m. and 7 p. m. was amply sufficient to have caused the trouble in the boiler.

"I figured that to be found with such regularity, the acid must have been dumped into the river. Finding out by whom wasn't so hard when

we knew what we were looking for, as across and a little way up the river was a process mill. From there, because of a bend, the current swept to the opposite side of the stream and along the shore in front of the big plant.

"A call at the process mill justified my suspicions as well as the findings based on the hourly water tests. By a coincidence the process mill emptied its vats of waste acid into the river at times which happened to be only a few minutes after the big plant's regular times for testing its feed water.

"The big plant had been taking in necessary makeup water shortly after the tests so that a portion of this acid found its way into the boiler and ate away at the shell plates and tubes to its heart's content.

"By the time of the next feed water test, however, the current had carried sufficient of the acid out of that part of the river so that the water showed alkaline after the usual regular feed water treatments had been made.

"The condition was improved by arranging to have the up river plant put the acid into the river continuously, instead of releasing it in large quantities. The treatment of the feed water at the big plant was then altered to prevent further corrosive action taking place in the boilers.

"Since that time, in keeping with the policy so widely in effect on the part of large power plants, they have, of course, set up a system of feed water testing that is practically continuous, and the last time I was talking to the superintendent he told me that the saving from having clean boilers has justified many times the cost of frequent testing.

"It would be very unlikely for corrosive action due to a high acid content of the feed water to develop at that plant now at any time of day. The continuous testing would detect any change at once and give the signal for a variation in water treatment."