Consumers' Research

Organized and incorporated under the laws of the State of New York as a membership corporation to provide unbiased information and counsel on goods bought by the ultimate consumer; not a business enterprise, not operated for profit.

24 West 25th St. **New York City**

HANDBOOK *of* BUYING

July
1 9 3 2

Volume VII
Part 2

of 3 or 4 parts comprising a complete year's issue.

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The information contained herein supersedes that on the same subjects in all previous material issued by Consumers' Research.

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SYMBOLS

A—recommended on basis of quality.

AA—regarded as worthy of highest recommendation.

ad—criticisms based on objections to the recommendations or claims made in the advertising of the product.

B—intermediate with respect to quality.

bs—information from findings of Bureau of Standards.

C—not recommended on basis of quality.

cr—information from Consumers' Research's own tests or investigations.

d—information from American Dental Association.

g—information from U. S. and state government sources like the Federal Trade Commission and the Food and Drug Administration.

lqwp—large quantity wholesale price.

m—information from American Medical Association.

pd—dental information from private sources.

pm—medical information from private sources.

p—information from private sources which has been carefully considered or studied by Consumers' Research and accepted as worthy of notice by consumers interested in the subject discussed.

pt—confidential information from expert technicians or scientists.

pts—based upon unpublished experimentation, equivalent to ex as used in some previous Handbooks.

t—a matter of general technical knowledge; reference unnecessary.

ts—based on published experimentation but reference omitted on account of space limitations; equivalent to exu as used in some previous Handbooks.

u—unlisted. The source is a book or published document reference to which is omitted on account of space limitations, usually because the item is not controversial or because it is generally known among technicians skilled in the field.

wd—purchase may advantageously be made from a wholesale druggist.

$—criticism based on price. In the absence of sufficiently fine gradation to permit the use of the symbolism given below **(1, 2, 3),** if the $ appears without other information in connection with an item in the **B** column, for example, the item may be a desirable purchase for those in such circumstances that cost need not be considered, or when the corresponding item in the **A** list is not obtainable.

1, 2, 3—relative prices, **1** being low, **3,** high. Thus **A1** would mean "superior product at relatively low price," **A2** "superior product at medium price," **A3** "superior product at relatively high price."

31, 32—years in which the information was published or obtained by the staff of Consumers' Research. Thus "pt 31" would mean "obtained in 1931 from private expert technical sources."

ABBREVIATIONS

A.D.A.—American Dental Association
A.G.A.—American Gas Association
Agric. Exp. Sta.—Agricultural Experiment Station
A.M.A.—American Medical Association
Bur. Home Ec.—Bureau of Home Economics (Dept. of Agriculture, Washington, D. C.)
Bu. Stan. or Bur. of St.—U. S. Bureau of Standards
Exp. Sta.—Experiment Station
F.T.C.—Federal Trade Commission
U.S.D.A. (or U. S. Dept. of Agric.)—U. S. Department of Agriculture
U.S.P.—United States Pharmacopeia
U.S.P.X.—Tenth (current) revision of the United States Pharmacopeia

PURPOSE OF THE LIST

The list is to be regarded purely as a series of suggestions. It can make no pretense either to completeness or unfailing exactness of information, due to unavoidable limitations on the time of the staff and of those supplying the original data. Except when clearly ascribed to authoritative sources, the recommendations should be regarded as the private opinions and suggestions of private persons. Wherever the symbol pt is used, however, the person responsible for the suggestion is a technical expert of some kind, and in many cases a very high authority in the field. In compiling this list the technical staff of Consumers' Research, to the extent of its ability, which, without argument, we freely admit to have serious limitations, aims to act as consulting expert for individual members, giving the kind of advice available to large buyers through their consulting experts and chemists. A more detailed explanation of the sources of CR's information and its methods of work may be found in the *Introduction to Consumers' Research,* available free on request.

Discussion of furniture and household textiles, inclusion of which in this section was announced as a possibility, has been postponed to Part 3, the next Handbook. Regarding the information included in the present Handbook, we feel that some explanation of the quality of certain parts is due our subscribers, not as an apology, since we believe that we have presented as useful material as is possible in the circumstances, but rather in order to make for clearer understanding of the difficulties which any person or organization trying to chart a course in a hitherto unexplored and unpublished technology must overcome. We are as aware as will be any of our subscribers that some of the sections of this Handbook dealing with building materials are not so directly and immediately useful as brand name listings would be. The limitations are, however, largely in the subjects themselves and not in our treatment of them.

There is, in connection with house building materials, a vast fund of information in possession of manufacturers, commercial testing laboratories, U. S. Bureau of Standards, and the Supervising Architect of the Treasury Department and of State governments. None of this information is, however, available either to us or to the ultimate consumer, except as it finds its way, usually in commercially biased and misleading form, into advertisements. Despite these limitations, however, we judge that the only specially significant omission from this Handbook is a discussion of house paints, which may, in so far as information is obtainable and to the extent that time permits, be supplied subscribers at a later date (possibly as a mimeographed bulletin at 10 cents).

Where our information is admittedly deficient, we have made some attempt to fill in the gaps by referring to the most useful books or to government, university, and state experiment station pamphlets. Most university and state experiment station bulletins are free, but their distribution is often confined to residents of the state. The U. S. Government material, when free, can be had from the office of the bureau issuing it; when for sale, it is to be had from the Superintendent of Documents, Government Printing Office, Washington, D. C. Payment must be made in advance in the form of government document coupons (obtainable at 5c each from the Superintendent of Documents), Post Office money orders, or cash; checks and postage stamps are not accepted. Consumers should not only obtain such material when it exists, but when it is lacking or refused them, they should protest in writing to their Congressmen and to the bureaus involved. In this way it may be possible for consumers to influence the government to devote to subjects directly useful to the ultimate consumer some of the many millions of dollars which it annually spends on tests and experiments, and to publish what it finds without regard to the commercial interests affected. Find out what your state university or agricultural experiment station is doing. If it is work of value only to business men, write to your legislators and object. The rights of consumers are gradually coming to be recognized, but they will be respected only when consumers vigorously voice their demands. Chambers of Commerce and the National Association of Manufacturers obtain what they want of the government by asking for it, loudly and repeatedly if necessary. In self defense and for the general good, consumers must do the same.

Subscribers are reminded that the very low price they pay for a year's subscription does not give CR sufficient funds to answer their personal inquiries without an additional charge (minimum charge $2).

It should be clearly understood that the purpose of this rule is not to increase our income by providing an inquiry service on a fee basis (as a matter of fact the fees charged have never sufficed to make the special inquiry service self-supporting) but rather to insure complete fairness to all subscribers by allowing them to share equally the results of all the work made possible by their annual fees of $2. Since CR is not a business enterprise we feel under definite obligation so to conduct our work as to provide the maximum of benefits to our average subscriber.

When, in exceptional cases, subscribers' inquiries can be answered, the following charges (remitted in advance) approximately apply:

1. For inquiries in connection with which material is readily available, though perhaps not assembled for ready use ..... $2 to $5
2. For inquiries in connection with which consultation or reference of the problem to an outside expert is necessary, $5, or the consultant's per-question charge to CR (usually $5) plus a $1 service fee to cover our costs in carrying on an intermediary and interpretative correspondence. (Should no usable and useful information be developed by this method, all but the $1 service fee will be refunded, unless CR is out of pocket on the consultant's fee, in which case the subscriber will necessarily have to bear the latter also.)
3. For inquiries which would necessitate considerable collation or verification of expert opinion.... $5 to $20
4. For inquiries which would necessitate test..... the actual testing fee charged by whatever laboratory is engaged for the work, with the understanding that all test results are to be made available to CR.

HEATING AND VENTILATING

FUEL AND FUEL SAVING

COAL

Hand firing of coal in heating furnaces is subject to wide variation, depending on the size and type of furnace, the kind and size of coal, the draft, and the attention given the firing. Best results are undoubtedly obtained with *anthracite*, because of its uniformity and cleanliness, but the price is sometimes prohibitive except in the East. Where anthracite is available, it is cheaper to burn the smaller sizes: chestnut, 1 to 1⅝ in., with good natural draft; pea, ⅝ to 1 in., and No. 1 buckwheat, 5/16 to ⅝ in., with either natural draft or blower—depending on the draft; and rice, 5/16 to ⅝ in., with a forced draft blower. Anthracite coal should conform to specifications about as follows: 12,500 Btu; and no more than 12% ash, 3.6% moisture, 1% sulphur, 10% volatile. (pt 32 + u 23) In any case, small mesh grates are advisable; otherwise it is necessary to keep a thick layer of ashes under the fuel to reduce the loss (percolation) of coal; this layer materially reduces the draft. Keep fire pot full to the level of the fire door. In mild weather allow ashes to accumulate on grate to slow combustion. pt 32

Semi-bituminous coal, such as *Pocahontas* and *New River* (from mines in W. Va. only) is available as "stoker" coal in some localities, and compares in price and size with buckwheat. Its advantages are the highest heat value per lb of any coal, low ash and volatile matter; its disadvantages: more dirt and smoke than from anthracite (but less than from bituminous coal). Semi-bituminous coal should conform to specifications about as follows: 14,000 Btu; and no more than 7% ash, 3% moisture, 1½% sulphur, 25% volatile. pt 32 + u 23

Bituminous coals are the most widely distributed, and the only ones available in many localities. They are high in volatile matter, which distills off quickly when coal is fed into the furnace; most of the volatile matter passes unburned into the chimney, with resultant loss of heat value. Western coals are more volatile than Eastern. Eastern bitu-

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

A *Recommended* B *Intermediate* C *Not Recommended*

minous coal should conform to specifications about as follows: 13,000 Btu; and no more than 9% ash, 3% moisture, 2% sulphur, 25 to 35% volatile. For Western bituminous, specifications are less strict. pt 32 + u 23

Buy fuel from reputable dealers only. Even if you are convinced of a dealer's honesty it is well to provide for his removal of coal if it does not meet specifications. This is likely to be very expensive for the dealer. Use grade and size of fuel best suited for your furnace or boiler, as recommended by the manufacturer (not by coal dealer) if you cannot get sound technical advice on burning of smaller, cheaper, sizes. Fuels containing a high percentage of volatile matter (large percentage of gases) require greater combustion space above the fire than those containing less gas and a greater percentage of carbon. Comparison of the relative merits of coal should be made from the following data which can be supplied by the dealer or directly from the supplying mine, of which the dealer can give the name. Large users should buy on *guaranteed* figures for these data, and occasionally arrange for a test to confirm delivery of the stated grade of fuel. Ultimate consumers could, by acting in clubs or groups, buy on specifications and have tests made. pt 32

Btu (British thermal units) value, percentage of ash, percentage of volatile matter, and percentage of sulphur. Other items to be considered are convenience in handling, uniformity of size, ease of igniting, burning qualities, freedom from dirt, slate, and other impurities. There is no objection to higher moisture content if dealers allow for it in weighing and do not charge for it. cr 32

Coal briquettes except when purchased on *guaranteed* maximum ash content. Some give very high ash. p 28

For economical operation, clean the heating surfaces and passageways in furnace at least once a week. Clean smoke pipe and chimney once a year with hard coal, oftener with soft. Remove ashes daily. Piling up of ashes will cause burning out of grates. Do not shake grates too long, and remove clinkers with as little disturbance of fire as possible. Never shake or disturb a very low fire until you have ignited a little fresh fuel. Comfort depends on temperature, relative humidity, and freedom from draught, but in general keep the temperature of your house not over 70° F. Heating to 75° F, instead of 70° F, with an average outdoor temperature of 40° F means, for the entire heating season, a 17% increase in fuel consumption. pt 32

Proper firing, as follows for volatile coals, reduces fuel consumption: First rake a part of the coals into that part of the grate over which the gases pass last on their way to the smoke flue (look at the top of the firebox for direction of flow). Then shovel the fresh coal onto the partially uncovered part of the grate, allowing it to coke from 2 to 5 hours. Then spread it over the grate, where it will burn for some time without flame. This method of firing requires fairly frequent attention, but will increase efficiency. Where the draft is poor try sprinkling a small amount of water over the coal just before firing. Do *not* sprinkle water on the whole pile; to do so may cause spontaneous combustion. Use very little water—too much causes a large heat loss up the chimney. The water, it is believed, makes the fine coal particles stick to the larger ones instead of filling up the space between, thus keeping the draft passages through the fuel bed open and allowing a better draft. It is possible to buy coal which has been air-cleaned or subjected to a process combining air-cleaning and sand-blasting, by which slate and particles of material heavier than coal will have been removed. If consumers bring pressure to bear on their dealers to supply them with air-cleaned coal, they will probably hasten the process of having such coal more widely available on the market. pt 32

A *Recommended* B *Intermediate* C *Not Recommended*

The proper mixture of air in the furnace is as important as it is in a carburetor. Open the ashpit damper enough to get a good draft through the fire, then open the slots in the fire door to admit enough air over the fire to cut down the smoke until it is a bare haze (with anthracite, until a blue, gas-like flame is produced). The fire may be checked with a damper in the smoke-flue if the furnace is tight, but the ash-pit damper must be closed off if it is not. See that all joints are tight with stove cement. Cracks between ashpit and floor can be sealed with a soft mixture of three parts sand and one of cement, after first washing surface with water. Do not check the fire by opening the fire door, as this causes a heat loss up the chimney. pt 32

Coal Saving Nostrums

In general, all devices claimed to save 10% to 50% of coal by means of admission of air above the fire should be avoided. g

Products to be sprinkled on or mixed with the coal supply to save fuel are practically all in the class of quack medicines. u

Craigulator g 30

Mineral Coal Saver (Mineral Coal Saver Co., Mennie Mfg. Co., and M. & K. Mfg. Co., Omaha, Neb.) Consisted principally of common salt. F.T.C. ordered these companies to cease advertising that product will make poor coal good and good coal better. g 30

References

Keystone Coal Buyers Catalog & Mine Directory, 757 pp., New York: McGraw-Hill Catalog & Directory Co., 1932. Characteristics and analyses of coals. Available for reference at public libraries.

Analyses of Samples of Delivered Coal Collected from July 1, 1915, to Jan. 1, 1922—Bu. of Mines Bul. 230, by Ned H. Snyder. 20c from Supt. of Docs. 174 pp., Washington: Dept. of the Interior, 1923.

The Economical Purchase and Use of Coal for Heating Homes with Special Reference to Conditions in Illinois—Eng. Exp. Sta. Circ. 4. 10c. Urbana: Univ. of Ill., 1917.

Firing Bituminous Coals in Large House-Heating Boilers—Bu. of Mines Tech. Paper 180, by S. B. Flagg. 5c from Supt. of Docs. 22 pp., illus. Washington: Dept. of the Interior, 1917.

Five Hundred Tests of Various Coals in House-Heating Boilers—Bu. of Mines Bul. 276, by P. Nichols, S. B. Flagg, and C. E. Augustine. 15c from Supt of Docs. 74 pp., illus. Washington: U. S. Dept. of Commerce, 1928.

Five Ways of Saving Fuel in Heating Houses—Bu. of Mines Tech. Paper 199, by Henry Kreisinger. 5c from Supt. of Docs. 13 pp., illus. Washington: Dept. of the Interior, 1918.

Saving Fuel in Heating a House—Bu. of Mines Tech. Paper 97, by L. P. Breckenridge and S. B. Flagg. 5c from Supt. of Docs. 35 pp., illus. Washington: Dept. of the Interior, 1917.

COKE

Solvay, Koppers, and gas-house coke give more heat units per dollar than any other fuel with the possible exception of coke from refineries, obtainable near oil refining centers. Coke gives a hot flame and burns without smoke, but is hard to start and to bank, thus burning out quickly. The best coke to obviate this condition is that made by comparatively low temperature carbonization of the coal, which has a dark

color, and is soft. Coke is sometimes rendered dustless by treatment with calcium chloride. Such coke gives off free chlorine when burned and may have the disadvantage in practice of corrosive action on metal and bleaching action on any organic substance (cloth, paper, etc.). pt 32

References

Comparative Tests of By-Product Coke and Other Fuels for House-Heating Boilers—Bu. of Mines Tech. Paper 315, by Henry Kreisinger, John Blizard, H. W. Jarrett and J. J. McKitterick. 5c from Supt. of Docs. 21 pp., illus. Washington: Dept. of the Interior, 1923.

Why and How Coke Should Be Used for Domestic Heating—Bu. of Mines Tech. Paper 242, by Henry Kreisinger and A. C. Fieldner. 5c from Supt. of Docs. 20 pp., illus. Washington: Dept. of the Interior, 1919.

OIL

The grade of oil to be used depends entirely on the design of the burner installed, but most modern burners are designed to burn the heavier grades. If trouble from smoke and uneconomical operation are to be obviated, the oil delivered must be within the limits of density which the burner requires, and most reputable dealers take care to see that it is uniform. If fuel does not run uniformly, the user will soon find it out through his burner smoking and his chimney emitting an oily smell. If the oil varies, the adjustment of the burner must be changed, allowing possibility of poor combustion efficiency, which is dependent on proper burner adjustment. Usually the oil dealer finds it to his advantage to furnish uniform oil, because pumping out the user's oil tank is expensive and may lose a customer. A *Tag* oil hydrometer may be purchased complete with case and test cup from Preferred Utilities Co. (33 W. 60 St., New York City) for $8.55, dealers' price 33⅓% off. Oil of independent dealers generally varies more in quality than that of the larger oil companies. Some dealers furnish contracts to keep the tank full without the trouble of calling them, and also set a maximum price, protecting the purchaser from excessive rise in the market while giving him the benefit of any reductions. pt 32

Use only the grade of oil recommended for burner and see that specific gravity of all deliveries is as follows:

No. 1 oil—38° to 40° Baumé; greater number Btu per lb, less pounds per gal than No. 2.

No. 2 oil—28° to 32° Baumé; less Btu per lb, but enough more lbs per gal to give greater heat value per gal than No. 1.

No. 3 oil—14° to 16° Baumé; not recommended for use in full automatic domestic burner equipment. pt 32

GAS

Natural gas is supplied without admixture in certain districts of the East and Southwest, and, in other localities, is combined with manufactured gas in order to enrich the latter. Amount of gas required for a given purpose is *reduced exactly to the extent* that the Btu value of the gas is increased, in spite of contrary statements by the industry. House heating with gas, having the advantages of cleanliness, efficiency, and quick response to automatic control, may be advantageous when a special rate is offered for heating. Unless, however, other fuels are abnormally expensive, it is seldom economical to use gas, and the saving through shutdown of the system at night is negligible, unless the system is controlled by thermostat and the temperature not allowed to drop more than 12° or 16° below the daytime normal (70° F). pt 32

References

Carbon Monoxide Hazards from House Heaters Burning Natural Gas—Bu. of Mines Tech. Paper 337. 10c from Supt. of Docs. 31 pp., illus. Washington: Dept. of the Interior, 1923.

How To Get Better Service With Less Natural Gas in Domestic Gas Appliances—Bu. Stan. Circ. 116. 5c from Supt. of Docs. 5 pp. Washington: Dept. of Commerce, 1921.

Manufactured Gas in the Home—Smithsonian Inst. Bul. 102, *Part* 8, by Samuel S. Wyer. 10c from Supt. of Docs. 24 pp., illus. Washington: U. S. National Museum, 1923.

Natural-Gas Manual for the Home—Bu. of Mines Tech. Paper 325, by R. A. Cattell. 10c from Supt. of Docs. 30 pp., illus. Washington: Dept. of the Interior, 1922.

Waste and Correct Use of Natural Gas in the Home—Bu. of Mines Tech. Paper 257. 5c from Supt. of Docs. 23 pp., illus. Washington: Dept. of the Interior, 1920.

American Gas Association, Inc., Testing Laboratory (1032 East 62 St., Cleveland, Ohio). List of approved gas appliances (revised monthly), $2 a year. Excellent technical laboratory. Subscribers are strongly urged to ascertain that any gas appliances they contemplate buying are on this list, which may be found at libraries. The A. G. A. laboratory seal of approval is fundamentally a guarantee that appliances to which it is attached comply with A. G. A.'s own basic requirements for safety and contain necessary features of design and construction essential to an acceptable but not necessarily superior operating efficiency. It is not at all a symbol of quality, except in the sense that very low quality and dangerous appliances, which are exceedingly common in the department store and house furnishing trades, are unable to pass anybody's standard requirements anywhere, and are therefore easily excluded by A. G. A. or other inspection and test criteria. Accessories of various kinds are not approved by the Association's laboratory as separate devices, but only as part of and in conjunction with appliances to which they are attached.

COMPARATIVE FUEL COSTS

For comparison of fuels in your locality, the following formula may be of assistance:

$$\text{Heat obtained for 1c} = \frac{\text{Heating value} \times \text{efficiency}}{\text{Cost of fuel}}$$

Heating value must be expressed in Btu per lb, gal, or cu ft, depending on fuel used. Cost of fuel must be expressed in cents per lb, gal, or cu ft.

For efficiencies use the following, which are average values:

	per cent efficiency
Semi-bituminous	47
Bituminous	45
Anthracite	50
Coke	47
Oil	60-65
Gas, with gas furnaces or direct heaters	75
Gas, with conversion burners	70
Electricity	100

pt 32

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

Comparative Costs, in the East, of Fuels Producing Equivalent Heating to that Obtained With $100 Worth of Semi-Bituminous Coal

(Based on efficiencies in previous table)

a. Semi-bituminous coal ($9 per ton)	$100
b. Natural gas (1100 Btu per cu ft at 40c per 1000)	70
c. No. 3 extra heavy oil (4½c per gal)	75
d. Bituminous coal ($7 per ton)	85
e. Buckwheat anthracite coal ($9 per ton)	95
f. Coke ($12 per ton)	140
g. No. 2 heavy oil (6c per gal)	100
h. No. 1 light oil (8c per gal)	145
i. Stove anthracite ($15 per ton)	160
j. Artificial gas (550 Btu at 75c per 1000)	255
k. Electricity (4c per kwh)	1,470

Costs are for fuel only and do not include interest on investment, depreciation, and special charges for electricity, gas, etc., for auxiliary mechanisms or ignition.

HEATING EQUIPMENT AND APPLIANCES

The words *guarantee, approved,* and *service,* which are most frequently played up in heating appliance sales talks and literature, have practically no meaning and provide no consumer safeguard except when qualified by a *clear written description* of the exact terms and limits of guarantee, approval (Underwriters' or other), and extent and duration of free servicing, repair, etc. Apparatus "guaranteed" for a given time in service has been customarily "talked out" of the customer's possession and replaced by the sale of new apparatus long before the expiration of the guarantee period; the consumer, failing competent, unbiased technical advice, can but follow advice from the dealer, who naturally has a strong motivation towards selling a new appliance, since his profit from a sale would be much larger than would that from a repair. Usually some part of an appliance, perhaps a minor one, develops trouble, and after a few half-hearted attempts to repair it the dealer sends a high-pressure salesman who, with proper rationalization, recommends the purchase of a complete new appliance. In one such case an engineer who was consulted found that a storage type heater, which the salesman had said was completely worn out, would, with replacement of an inexpensive thermostatic control, probably give another ten years' service. The dealer admitted that his salesman might have been "overzealous." pt 32

HEATING SYSTEMS

Selection of the type of heating system to be installed in any house requires careful consideration of the following points:

(1) Heating requirements: interior temperatures required; characteristics of house—its size; its construction and materials—wood, brick, stone, and their heat-transmitting properties; thickness of walls; insulation; number and size of windows; climate and wind exposure, which determine sq ft radiation required.

(2) Cost: initial investment; interest on investment; amortization.

(3) Cost of operation: cost of fuel compared with other types of fuel, including gas or electricity for auxiliary apparatus; cost of servicing, ash handling; cost of probable repair requirements.

(4) Ease of operation: availability of fuel; availability of servicing, repairs, and replacement; cleanliness; method of handling fuel and ashes.

The proper type of system will give even heating and good control, with economical fuel and operation costs, and a low rate of depreciation.

A B C

Recommended *Intermediate* *Not Recommended*

It is conservatively estimated that eight out of every ten home heating systems are deficient in one or all of three essentials: the amount of radiating surface, the size of piping, and the size of the boiler, all of which are interdependent for satisfactory and economical operation. Modern practice makes possible the uniform heating of any space and satisfactory heating of "cold rooms" in exposed locations. Uneven heating and insufficient heat on cold days are most often due to faulty installation and the contractor's ignorance of fundamental principles, and should not be accepted by purchasers as something that must be tolerated in heating practice. Probably no "speculative" house was ever built in the United States with sufficient heating facilities. A faulty heating system has often caused damage to health and rendered space unfit for use in cold weather, for which loss of value owners have sought redress in the courts. Such litigation is, however, generally useless unless services of a competent engineer-specialist are used to establish and testify to standards to which he may relate fundamental deficiencies in the heating plant. pt 32

Relative first costs and operating costs will vary. In a small residence (up to 8 rooms), a hot water system will be lowest in installation cost and about medium in operating cost; warm air system medium in installation, lowest in operating cost; vapor system medium in installation, highest in operating cost. In a residence of from 8 to 15 rooms, a hot water system will be medium both in operation and installation; warm air high in installation but lowest in operating cost; vapor system medium in both—about the same as hot water. In a residence larger than 15 rooms a hot water system will be medium in installation and low in operating cost; forced warm air system highest in installation, lowest in operating cost; vapor system lowest in installation, medium in operating cost. Heat-delivery characteristics, such as rapid fluctuations in temperature, also have a bearing upon the selection of a heating system, as a steam or vapor system is more responsive, heating quickly and cooling off quickly. Feasibility of using concealed radiators, particularly those of the copper extended surface type, is also in a measure determined by the heating system. The larger radiators required by hot water systems take up more room and often necessitate expensive structural alterations to provide recesses of the proper size. pt 32

The selection of a reputable contractor is of prime importance. Members of the Heating and Piping Contractors National Association (50 Union Square, New York City) and of the National Warm Air Heating Association (174 East Long Street, Columbus, Ohio) are usually more reliable than the average in so far as they may observe and follow the principles of design and workmanship set up by the associations. Consumers should bear in mind, however, that in most matters trade associations function primarily for the benefit of their members. (See General Bulletin, Vol. 1, No. 1, Sept. 1931, on selling policy of one of these heating trade associations.) Owners should investigate the financial status and reputation of any individual contractor before signing a contract. Good contractors are capable of designing and installing satisfactory systems of the smaller sizes when using the data of their associations, and the use of these data should be called for *in the contract* as the basis of design. cr 32

Avoid contracts for heating "systems" advertised by boiler, radiator, and heating specialty companies. Such companies are interested only in selling their own equipment to the exclusion of all others, whether theirs is well suited for the job or not, and their contracts are practically worthless so far as protection of the consumer is concerned. Insist on the inclusion of the following provisions in the contract (and on the exclusion of contrary statements) and insist that these

provisions shall have been carried out before making final payment:

"The system shall be [give type] *and shall be complete and ready for use in every detail, and in operation. It is guaranteed by the contractor* [insert name] *to heat all parts and every room in the structure identified as* [state residence, or otherwise] *located at* [give street, no., city, state], *to a uniform inside temperature of* [usually 70 degrees, bathrooms 80 degrees] *at an outside temperature of* _____

[usually 15 degrees above the lowest recorded for the locality (data obtainable from the U. S. Weather Bureau, Washington, D. C.)]

The above results or their equivalent shall be obtained at a maximum rate of fuel consumption not exceeding [— lb fuel[1] per sq ft of grate area, gal[1] oil, or cu ft gas[1]] *per hour. The contractor* [insert name] *will replace free of charge to the owner any and all parts of the system which may fail through defective workmanship or material within a period of one year from date of accepted installation, which year shall entirely include one full heating season."*

Since economy and equivalent temperature tests are expensive, and not always entirely reliable, it is best, so far as possible, to obviate the necessity for them, by selecting a good contractor and insisting on equipment of proper size. pt 32

The easy financing schemes and time payment plans of many contractors and heating equipment companies are questionable, and in practically all cases money can be saved by using the facilities of a bank or of a building and loan association and paying the contractor as the work proceeds. The rates of interest being no greater (they are usually less at a bank), a definite advantage lies in the possibility of retaining 15% of the payments due the contractor until the system has been tested and proved satisfactory. Heating contractors customarily obtain cash on deferred payment contracts, secured by notes, by selling them outright to a "finance company." The proper functioning of the installation thereafter is a matter of no financial concern to the contractor, and the consumer can therefore hold no one directly responsible for satisfactory operation of the plant and may have no recourse, except to go to law—a course made particularly difficult by the shrewd construction of most installment contracts. Above all, sign no paper or statement releasing the obligation of the contractor, or stating that you accept and declare the installation or system to be entirely satisfactory, unless you have thoroughly tried it out under severe conditions. Systems satisfactory in a mild season may be seriously deficient in a cold season. pt 32

For large or unusual installations, employ a consulting engineer specializing in heating and ventilating to design and supervise the installation of the system. If there is reason to doubt the reliability of contractors, or if economically important advice is required, it will probably save you money to employ an engineer, the fee for his services being small in comparison with the troubles and direct and indirect costs which may be caused by ignorance and disregard of fundamental principles in the design of the system, selection of equipment, or the expense of lawsuits. The names of professional heating and ventilating engineers in your locality may be secured from your state board for registration of professional engineers, or the local chapters of the American Society of Mechanical Engineers (addresses may be had from the main offices at 29 W. 39 Street, New York City) and American Society of Heating and Ventilating Engineers (main office: 51 Madison Avenue, New York City). Be careful to select only such engineers as are in independent professional practice and not in any way connected with manufacturers, merchandising groups or associations, heating and plumbing jobbers or contractors, or public utility companies. A professional engineer must be in a position where he may be safely assumed to work entirely for the best interests *of the client who employs him* to the complete exclusion of any subsidizing interests whose products he might otherwise be anxious to influence his client to purchase. Some engineers specialize in and have facilities for the design of residence heating systems at reasonable fees consistent with the budget of the small home builder. pt 32

[1]Anthracite coal, according to size, 4 to 6 lb per sq ft grate area per hour; bituminous, 7; oil (at 140,000 Btu per gal) .03 gal per sq ft boiler heating surface per hour; gas combustion rates usually stipulated by boiler mfrs. for each size boiler.

STEAM, HOT WATER, AND VAPOR HEATING SYSTEMS

The one-pipe steam heating system, while lowest in installation cost, is the most expensive and least satisfactory in operation and necessitates unusual care in design and installation. Odors from air escaping into rooms, and difficulties with air valves, higher steam pressures, and odors from hot dust at high radiator temperatures are objectionable. Uniform temperature regulation is difficult. In the present state of the art a one-pipe steam heating system may be looked upon as obsolete. It can hardly be justified even on the low initial cost basis, because its cost of operation is so much greater than that for a vapor system that the excess fuel consumed will pay the additional cost of the better equipment in two, and frequently one year's operation. Apartment building speculators favor one-pipe steam for low first cost because most of them do not operate the buildings they build but sell to someone else who holds the bag. Unless the one-pipe system is extraordinarily well designed and installed, a consulting engineer is likely not to recommend mortgage loans upon the building in which it is used. Vacuum air-vent valves which will close against movement of outside air into the radiator, thus causing the system at such times to operate with a slight vacuum, will considerably improve the operation of a one-pipe system, if other essential parts—grate area, pipe size, radiating surface, etc.—are adequate in size for boiler efficiency. pt 32

A plain two-pipe system is more efficient and responsive than a one-pipe. Low pressure steam or vapor systems *without* radiator traps are modified two-pipe systems and are slightly more economical in operation. Low pressure steam or vapor systems *with* radiator traps are more economical and responsive in operation than any of the foregoing. Installation cost in the latter case is slightly more than that of a hot water system in small buildings, and less in larger ones. Smaller radiators and smaller piping are used in steam systems than in hot water systems. Steam equipment is more complicated in installation and requires greater care in maintenance. A steam or vapor heating system requires frequent cleaning out; and traps on radiators, return trap at boiler, and air vent valves on mains must be regularly examined and cleaned. pt 32

Avoid complicated systems for small residences. Rugged construction and notable simplicity of valves, traps, and other equipment should be governing factors in selection. Ample down grade of main piping in direction of steam flow is essential. The most frequent causes of trouble are dirt and grease in a system. When the system is newly installed, require, before it is accepted for operation, that all traces of grease be removed from boiling water. Watch gauge glass for dirty water thereafter. pt 32

Steam boilers should be thoroughly cleaned and drained during the last month of operation, so as to remove all scale and accumulated matter from the water-leg of the boiler. They should then be refilled and operated for two weeks or so, in

order to drive all the free oxygen out of the water. Water should not, however, be drained off from the system during the summer months. pt 32

CAST IRON RADIATORS

Hot water and steam radiators are sold by the square foot of heating surface, normally 26c to 32c per sq ft ("distress" merchandise at present as low as 18c per sq ft). Hot water radiators are 37% larger than steam radiators, 37% heavier, and cost 37% more per radiator of the same heating effect. pt 32

Most manufacturers have discontinued the old column type of radiator in favor of the tubular type. Thin (3 tube) low radiators, under 26 inches, are more efficient than the thicker or higher ones. Radiation should be distributed for most satisfactory results, both in single rooms and throughout the building, and should be placed under windows whenever possible or on or near outside walls. It is better to use a number of smaller radiators, distributed under several windows in a room, rather than one large one. Do not place radiator on inside wall of room. Radiators under windows should extend in length to full size of window opening so that incoming cold air will mix with rising warm air from radiator when window is open instead of falling past the ends of radiators and developing cold drafts on the floor. Cast iron radiators are sold by the square foot of radiating surface at a price (1932) varying from 26c to 32c per sq ft depending on number of sections and height. A square foot of steam radiation is based upon an emission of 240 heat units (Btu) per hour when standing in still air. Hot water radiation, 150 Btu per hour. pt 32

Corto (American Radiator Co., 40 W. 40 St., New York City) pt 32

Aero (National Radiator Corp., Johnstown, Pa.) pt 32

Pierce-Eastwood (Pierce, Butler & Pierce Mfg. Corp., 41 E. 42 St., New York City) pt 32

Richmond Radiator Co. (1480 Broadway, New York City) pt 32

H. B. Smith Co. (Westfield, Mass.) pt 32

Crane Co. (836 S. Michigan Ave., Chicago) pt 32

PAINTING CAST IRON RADIATORS

As compared with the bare iron radiator, a coat of linseed oil, zinc, and lithopone paint of cream color will *increase* the heat given off by 4%; if a brown color is used, 5%; white gloss enamel, 2%; gray paint, 1%; aluminum bronze and gold bronze will *decrease* the heat output by 7%. ts 31

Reference

Painting of Steam and Hot Water Radiators, Letter Circular 263, 5 pp. Washington: U. S. Bu. Stan. Revised 1929. Free.

EXTENDED SURFACE TYPE RADIATORS

Extended surface type radiators for installation in walls and requiring no floor space, usually made of copper tubing with copper or aluminum fins, have come into fairly general use with hot water and steam heating systems. With hot water it is desirable that the radiator element have a large water-holding capacity to allow longer carry-over of heat when fire is banked or low. Avoid radiators with small tubes for hot water; they should preferably have few tubes of large area (½ in. tubes or larger) instead of many small ones.

A B C

Recommended *Intermediate* *Not Recommended*

These radiators are more efficient in heat transfer than cast iron, maintain better equality between floor and ceiling temperatures, heat up and cool off faster, weigh only a fraction as much as cast iron radiators of equal capacity, and take up much less space even when installed in exposed metal cabinets. pt 32

The recesses for radiators in outside walls should be insulated with ½ in. of rigid or flexible insulation for economy. Practically all manufacturers rate their extended surface radiators in square feet of equivalent direct cast iron radiation; this figure should be used as a basis of selection. Double tiers of this type of radiation do *not* give double capacity, though so rated by some manufacturers; the upper tier will increase the capacity of the lower by only 40%. Most radiator units are sold complete with enclosures and grilles. Expense and difficulty are avoided by purchasing units complete rather than a heating unit from one manufacturer and an enclosure from another. Prices approximate those of cast iron radiators but installation may be higher, due to cost of constructing and insulating recesses in walls, etc. pt 32

Erskine (Erskine Copper Radiator Corp., 1 E. 42 St., New York City) pt 32 **A1**

Trane (Trane Co., La Crosse, Wis.) Complete with enclosures. pt 32 **A1**

Murray (American Radiator Co., 40 W. 40 St., New York City) pt 32 **A2**

Rocop (Rome Radiation Co., Rome, N. Y.) Better for steam, cheaper design. pt 32 **A2**

Robras Box Fin (Rome Radiation Co., Rome, N. Y.) Good design for hot water heating but expensive. Enclosures separate. pt 32 **A3**

Herman Nelson (Herman Nelson Corp., Moline, Ill.) Possibly best in construction. Good for hot water. pt 32 **A3**

McQuay (McQuay Radiator Corp., 1600 N. E. Broadway, Minneapolis, Minn.) pt 32 **B2**

Modine (Modine Mfg. Co., Racine, Wis.) pt 32 **B2**

STEAM AND VAPOR HEATING SPECIALTIES

Steam and vapor heating specialties consisting of radiator valves, thermostatic traps, air vents, and return traps are sold by many manufacturers as heating "systems." These systems are designed by manufacturers to incorporate a maximum number of specialties, often to the point of neglecting other equally or more important component parts of the system, which the manufacturer does not sell. Specialty manufacturers sell the majority of their products by "designing" the heating systems in which their specialties are to be used, and advertising "free engineering," which is the bait set out to land the order. The engineering is, of course, not free, as its cost, plus a profit, is added to the cost of the specialties sold. Radiation in correct amount and of the proper type for the particular job and purpose, a boiler of sufficient capacity and correct operating and construction characteristics, the proper type of piping and insulation, and many other very important factors are made subordinate to the valve traps, air vents, return traps, and other miscellaneous patented articles which compose the products of the respective manufacturer's "system." Sales engineers familiar only with the products which it is their business to sell, *cannot* give proper counsel and consideration to other equally important components of a heating system, and if they can, they don't. By designing and specifying a job which is skimped on size and quality, particularly quality, in everything but radiator valves

A *Recommended* B *Intermediate* C *Not Recommended*

and the like, they are able to get the cost of the whole job down while getting a price for their own component goods out of all proportion to the cost of other far more essential items. pt 32

Valves, traps, etc., should be purchased as competitive equipment on the basis of quality and not on "free engineering" design service. Do not buy "systems" not fully guaranteed as to all parts including boilers, radiation, and piping, as well as the specialties. Specialty manufacturers guarantee only their own materials, and if they were required to guarantee *the entire job,* the cost of the work would be such that the engineering would be plainly anything but "free." pt 32

Radiator Traps

There is considerable difference of opinion as to the comparative qualities of the single diaphragm type and bellows type of thermostatic radiator traps. (Such traps keep the live steam from returning to the boiler, only water being allowed to pass.) Both have operated efficiently over a long period of time, although the bellows type has appeared longer lived in certain circumstances. pt 32

Jas. P. Marsh and Co. (Chicago) Products fair as to design. pt 32 **C1**

Barnes and Jones, Inc. (150 Brookside Ave., Boston) pt 32 **B1**

Grinnell Co. (Providence, R. I.) pt 32 **B1**

Trane Co. (Lacrosse, Wis.) Manufactures a good product for a low price, but agents are reported to be resorting to high pressure selling methods. pt 32 **B1**

C. A. Dunham Co. (450 E. Ohio St., Chicago) Good products, but are pioneers in the uneconomic practice of "free engineering." pt 32 **B2**

Hoffman Specialty Co. (Waterbury, Conn.) pt 32 **B3**

Webster, Warren & Co. (Camden, N. J.) Also a pioneer in "free engineering." pt 32 **B3**

Air Vent Valves for Steam Radiators

Air vent valves for use on one-pipe steam heating systems (systems in which the steam supply and condensed water flow in opposite directions through one connection) are made in two types: atmospheric, which permits air to return into the radiator when the steam pressure drops; and vacuum type, which closes against the admission of air after the radiator has once been filled with steam and then cools, thus holding a pressure below atmosphere in the radiator, under which steam can be generated at lower temperatures than 212° F. If the vacuum type valve is used—and it is the type to be preferred, for economical operation—the entire system must be tight and free from air leaks through the hundreds of points where small leaks may occur—at supply valves and boiler connections and piping. pt 32

Dole No. 2B (Dole Valve Co., 1913 Carroll Ave., Chicago) Vacuum type. pt 32 **AA1**

In-Airid No. 2 (American Radiator Co., 40 W. 40 St., New York City) Vacuum type. pt 32 **A1**

Dole Syphon Air Valve No. 1 (Dole Valve Co.) Atmospheric type. pt 32 **A1**

Before buying a valve of unknown make, be sure it is not of carbon post construction. pt 30

Hoffman No. 1 (Hoffman Specialty Co.) and a number of other thermostatic air valves are unsatisfactory with hard water, as needle valve seat hole, being very small, clogs easily. pt 30

Richardson & Boynton No. 1 (Richardson & Boynton, 260 Fifth Ave., New York City) Atmospheric type. pt 32 **A1**

Hoffman No. 2 (Hoffman Specialty Co., Waterbury, Conn.) Vacuum type. pt 32 **A2**

Airid No. 500 (American Radiator Co.) pt 32

HOT WATER HEATING SYSTEMS

Hot water heating systems are particularly adaptable to residential use and should be designed so that they will supply the heat needed without requiring the temperature of the water in the system to be raised above 180° F in the coldest weather. If a system fails to operate at this temperature in severe weather, the cause will be any one or all three of the following: insufficient radiator surface, piping too small, boiler too small. To overcome the difficulty perhaps all three will have to be corrected. The maximum water temperature required to furnish the stated temperature conditions should be named in the purchase contract, for protection of the purchaser. pt 32

For uniform heating each main should have as nearly as possible the same number of sq ft of radiator. Where boilers are located on south, or least exposed side, of building, uniform distribution can be obtained by carrying the supply main to the opposite (north) side and so distributing heat first to the radiators which are farthest from the boiler and which, by reason of their being on the exposed side of the building, require the most heat. pt 32

Advantages of hot water heating systems: low temperature heating medium and consequent freedom from odors sometimes caused by steam, longer carry-over of heat after fire is banked, maximum simplicity and economy of operation, slightly greater efficiency with intermittently operating firing devices, such as oil burners and gas burners. pt 32

Water should not be drained from the hot water systems during the summer months. pt 32

HOT WATER SYSTEMS, PRESSURE TYPE

The purpose of a pressure system is to compensate by raising the water temperature (up to a maximum of 220° F) for insufficient radiation and skimped piping (causing too low velocity of circulation of hot water). Its operation is, however, decidedly uneconomic, as the increase in the amount of fuel required to maintain higher water temperatures is far greater than the increase in heat-yield. (Economical operation calls for water no hotter than 180° F.) Nevertheless, given an inefficient hot water system already installed, it may be desirable, even with resultant increased operating costs, to convert it from a gravity open tank system to a closed system operating under pressure at higher water temperatures. This is done by the use of a pressure-reducing valve on the cold water line supplying the boiler and relief valves, with consequent elimination of the expansion tank. Even in this case, if the piping is much too small, it may not be possible to get sufficient heating effect because of the too slow flow of water through the system. pt 32

Pressure systems require better than ordinary radiator valves. High temperatures cause more rapid disintegration of packings, and leaks, when they develop, will be more serious because the loss in pressure due to the leak is constantly being made up by the pressure-reducing valve, so that water may squirt out over floors and furnishings. pt 32

Watts Regulator Co. (256 Lowell St., Lawrence, Mass.) pt 32 **A1**

D. & T. Mfg. Co. (3001 La Salle St., Chicago) pt 32 **A2**

H. A. Thrush & Co. (Peru, Ind.) pt 32 **A3**

Claims of hot water specialty manufacturers that smaller pipe sizes may be used with their equipment should not be followed as increased friction of unduly small piping will cause fuel waste. Savings claimed with closed system specialties

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

A *Recommended* B *Intermediate* C *Not Recommended*

are negligible, and only occur in a few instances in connection with salvaging plants which were originally improperly designed and installed. pt 32

Mueller Co. (Decatur, Ill.) pt 32

Valves for Hot Water Systems

Valves should open full with one-half to one turn. Packless valves of bellows type are recommended for pressure or closed-type hot water systems. Avoid valves with soft composition (hard rubber, etc.) seats. Valves should open to full area of supply pipe. Avoid wood handles. pt 32

American Radiator Co. No. 901 (40 W. 40 St., New York City) pt 32 A1

Crane Company (836 S. Michigan Ave., Chicago) pt 32 A1

Jenkins Bros. (80 White St., New York City) pt 32 A1

Sears, Roebuck & Co. (Chicago) pt 32 A1

WATER CIRCULATORS

Electric motor driven circulators may be used with good results on systems or mains where piping is undersized, and long horizontal runs cause sluggish operation. pt 32

Compeller (Sterling Engg. Co., 3738 N. Holton St., Milwaukee, Wis.) pt 32 A1

Hydrolator (Janette Mfg. Co., 556 W. Monroe St., Chicago) pt 32 A1

Water circulators obstructing normal gravity flow (pump type) which must operate continually are uneconomical, and are apt to increase circulation difficulties, when stopped. Circulators will make any system more responsive, at the expense of electrical energy ($) consumed. To effect any savings, electricity required must cost less than additional fuel for maintaining temperatures sufficient to give adequate water circulation. pt 32

H. A. Thrush & Co. pt 32 B1

Watts Regulator Co. pt 32 B1

PIPE

WROUGHT IRON AND STEEL PIPE

Steel pipe, preferably scale free, will fulfill requirements of average use. Experience has shown that except under unusual conditions such pipe is quite as durable as more expensive types of ferrous pipe. Wrought iron pipe should be used in preference to steel for underground water, steam, and particularly condensation return lines in moist locations. No general and universally applicable statement as to wrought iron pipe can be made. In many cases it is advisable to use wrought iron for hot water piping where one cannot afford copper. Selection of proper piping material should be governed almost entirely by the conditions and functions of the job, including the character of the water used, as to its content of gases and solids in solution. Ask your local water supply authorities, or power plant operators. pt 32

The first cost of wrought iron pipe is 72% more than steel, but its cost of installation is no higher. The higher initial cost of wrought iron pipe is frequently well justified, but an engineer's opinion should be obtained whenever possible. Both wrought iron and steel pipe nipples and couplings of reputable manufacturers are permanently marked for identification. In ordering wrought iron pipe it is necessary to insist on the word "genuine" before the trade name or brand of pipe desired. Trade practice has, as in the silk industry, for example, where pure dye silk is not necessarily either pure or all silk, allowed the abstraction of all binding significance from the normal descriptive term. pt 32

A *Recommended* B *Intermediate* C *Not Recommended*

Copper bearing steel pipe seems to have no qualities superior to steel for average use, considering the additional cost, except that it is more durable where exposed to atmospheric corrosion, as in vent pipes under 3 in. in size projecting above roofs; for this purpose it is not to be compared to cast iron (latter available only in the larger sizes). t

All piping, even though covered, should be painted with two coats of black asphaltum paint, or with blue or red lead. Such paint should be applied to the bare pipe before any covering is put on, and by preserving the piping will be worth far more than its small cost of application. pt 32

COPPER PIPE

Where long life is a major consideration, particularly in inaccessible locations, or where cost is not an object, copper pipe is very desirable. Copper pipe is frequently used for hot water supply and circulating systems; it will be found practically permanent in this use and has the advantage of assuring freedom from rust in the water. Copper piping in hot water systems should be connected with a copper or copper-lined heater; otherwise there may be difficulties from electrolysis (electrical corrosion action) and in consequence, increased rusting of the iron parts of the system. *A single iron fitting in a copper water supply system will impair the advantages for which the copper is purchased.* Copper pipe and fittings must have very clean-cut threads in order to make tight connections. No "pipe dope" should be used, and dies for threading copper pipe should not be used for other pipe. Purchaser should insist on Grade A copper piping or tubing, bearing the trademark of a reputable company. (pt 32) Flexible copper tubing should be 99% pure copper; copper and red brass pipe, 85% copper. A consulting engineer believes that copper is "very worthwhile in a small house considering small additional cost, but whenever I have specified copper pipe for a small house, the plumber has gotten the idea that the job is high class and that the owner is wealthy and has soaked the price beyond reason with higher percentage of profit. Cheaper pipe has become the earmark of the average job done at fair price [normal profit]." pt 32

The following companies supply satisfactory copper and brass piping meeting govt. specifications No. 342 (Grade A 83 to 86% copper; Grade B 65 to 68%; Grade C 59 to 65%):

Anaconda (American Brass Co., Waterbury, Conn.) pt 32

Chase Brass & Copper Co. (Waterbury, Conn.) pt 32

American Tube Works (10 Oliver St., Boston) pt 32

Paul Revere (Revere Copper & Brass, Inc., 230 Park Ave., New York City) pt 32

ALUMINUM TUBING

Aluminum tubing corrodes readily in contact with water, the resultant oxide seriously obstructing or even stopping flow.

INSULATING COVERING FOR HEATING PIPES AND BOILERS

Good piping and boiler insulation is an asset which will effect savings in operating steam or vapor heating systems. The boiler and all supply pipes and fittings should be completely covered with carefully applied plastic or moulded insulation. On hot water systems only the boiler and such piping as is run in outside walls or exposed in garages or open portions of basement need be covered; fuel savings from covering pipes are not usually sufficient to justify the investment when the pipes are in an enclosed basement. pt 32

A *Recommended* B *Intermediate* C *Not Recommended*

Much heat is lost from bare boilers. Manufacturers are attempting to meet this difficulty by offering metal boiler jackets which are filled more or less full of rock wool or other insulating material, and many use thin air cell board loosely applied. These metal coverings are not efficient unless the jacket is tightly packed full of insulating material and fits the boiler so closely that no air can leak in. Air leaks, through chinks and joints into air cell board insulation, render this material quite ineffective because of the convection currents set up. Many such jackets appear to have no other function than to improve the appearance of the boilers, giving them greater sales appeal, and to provide a surface upon which brightly colored paints may be applied. pt 32

For the average small boiler, probably the best insulating cover at small cost is 1½ to 2 in. of asbestos cement applied over wire mesh securely wired to the boiler. Portland cement is frequently mixed with the asbestos fibre to provide a smoother troweled surface and a harder finish. Many insulation jobs are spoiled by using too much cement; a small amount *in the finish coat* is sufficient and will make the covering wear longer. Magnesia block is a superior covering but costs much more. Over magnesia blocks asbestos cement must be applied to seal joints and to hold them together. Before any covering is applied to a heating boiler, make sure that all joints between sections are securely stopped with a good grade of furnace cement. pt 32

Asbestocel (Johns-Manville Corp., 294 Madison Ave., New York City) 8-ply. pt 32 **A1**

Carocel (Philip Carey Mfg. Co., Lockland, Ohio) 8-ply. pt 32 **A1**

Rock Wool (General Insulating & Mfg. Co., Alexandria, Ind.) pt 32 **A2**

4-ply coverings supposed to contain asbestos fibres are frequently no more than corrugated cardboard. pt 32

Air Cell (Philip Carey Mfg. Co.) 4-ply. pt 32 **B1**

Air Cell (Johns-Manville Corp.) 4-ply. pt 32 **B1**

Standard Sixcel (Standard Asbestos Mfg. Co., 822 W. Lake St., Chicago) 4-ply. pt 32 **B1**

Stanocel (Standard Asbestos Mfg. Co.) 8-ply. pt 32 **B2**

Mineral Felt (Mineral Felt Insulating Co., Toledo, Ohio) pt 32 **B2**

85% magnesia covering is manufactured by several companies and is an efficient insulator, but high in cost and difficult to apply because of mechanical weakness and tendency to fall apart. pt 32

RADIATOR COVERS AND ENCLOSURES

Most radiator covers or enclosures decrease the efficiency of the radiator in respect to steam consumption and temperatures at the breathing (face) level of the room. The few efficient ones have small widely spaced bars or metal grilles at front and ends, with (a) a large proportion of open space near the top of enclosure, equal to the depth of the radiator and extending its entire length; and (b) an open air inlet extending at least four inches from the floor. pt 32

In general, radiator covers present a better appearance than the bare radiator, and reduce smudging of walls, but are inordinately expensive due to inefficient production methods and gross waste because of lack of standardization of sizes and types. A reasonably priced radiator cover should at the present time cost not over $2 per ft length for an average width radiator from 20 to 30 in. high. This price is based on the cover's being of simple and efficient design, made of stamped 22 gauge sheet metal with reinforced corners, beading around top, and painted with a neutral color of metal primer so that purchaser may paint it to suit the color scheme of the room. With utter lack of standardization making it difficult to turn covers out in large production quantities, most of them are tailor-made jobs sold through salesmen who add a large margin for selling cost. The cabinet types of enclosure reduce the heat output of the radiator by 15 to 25%; shields, from 8 to 12%. pt 32

Radiator covers with so-called humidifiers are not effective; they require too much attention, are difficult to clean, and are unsanitary. exu 27 + pt 32 (See col. 34)

The following companies are suggested. In your order specify size of open space near top of enclosure and air inlet as indicated above.

Mullins Mfg. Corp. (1017 Mill St., Salem, Ohio) pt 32

Schleicher, Inc. (Gary, Ind.) pt 32

Sun Radiator Cover, Inc. (7802 Carnegie Ave., Cleveland, Ohio) pt 32

Thomas and Armstrong Co. (London, Ohio) pt 32

Tuttle and Bailey Mfg. Co. (441 Lexington Ave., New York City) pt 32

Reference

Investigation of Heating Rooms with Direct Steam Radiators Equipped with Enclosures and Shields—Eng. Exp. Sta. Bul. 192, by Arthur C. Willard, Alonzo P. Kratz, Maurice K. Fahnestock, and Seichi Konzo. 40c. Urbana: Univ. of Illinois, 1929.

WARM AIR HEATING SYSTEMS

One-pipe or pipeless furnaces. Often such furnaces are used in small one-storey houses with little better effect than the ordinary stove. If located in the center of the structure and provided with re-circulating ducts from registers located near the outside walls, in addition to the usual fresh air intake from outside (which should be equipped with a damper closely adjusted to weather and wind conditions), heat supply will be improved and less fuel will be required. pt 32

Gravity circulating pipe systems. These systems may be effectively used in small and compactly arranged buildings in which long ducts are not used. In all important rooms provision should be made for return of the air to the furnace, to prevent "dead pockets" and cold spots due to wind pressure, and to save fuel. Bathrooms and kitchens should have separate outside air vents to prevent circulation of odors. The large distributing ducts should "grade up" from the furnace. Even so, they materially reduce head room in the basement. pt 32

Forced positive circulation systems. Such systems, employing centrifugal fans, may be used in any structure; with them smaller ducts, often rectangular in shape, and longer duct runs may be used. The additional cost of operating fans depends on the size of the fan: for residences of 9 to 22 rooms it is about $2 per month. An air filter either of the dry type or that with oil, should be used to remove dust and dirt. Filters should be placed in the path of the return air and behind the fan. Air washers are beneficial for humidifying and for their cooling effect, when they can be supplied with a large volume of cold water at low cost. Air washers will remove a certain amount of dirt but have little effect in removing soot. Small pans connected with furnaces or in the bonnets (top covering or hood of furnace) have little

A *Recommended* B *Intermediate* C *Not Recommended*

effect in maintaining humidity. Pans having a large water surface exposed to warm air currents, and equipped with an automatic water feed and level regulator, will provide greater humidity but will not of course regulate for varying conditions. Excess humidification of the warm air supply will cause troublesome condensation on cold walls and frosting of windows in severe weather. pt 32

Warm air furnaces, to be used with gas or oil fuel, and in a forced circulation system, must be absolutely tight to prevent dangerous fumes, ash, and soot from being blown through the system. For oil firing, steel furnaces are preferable. The circulation, in the warm air supply of the house, of dangerous combustion gases, including the gaseous products of "back fires" or "puffs" from oil burners, can be prevented only by extreme care used to obtain absolute air tightness in all work on ducts and furnace casing. Before accepting a forced circulation warm air installation, insist upon smoke test under competent supervision, to prove the tightness of all duct work and the furnace casing. pt 32

Perfect (Richardson & Boynton Co., 260 Fifth Ave., New York City) Wrought steel. pt 32 **A1**

Torrid Zone (Lennox Furnace Co., Syracuse, N. Y.) Wrought steel, riveted; guaranteed for 10 years. pt 32 **A1**

Front Rank (Langenberg Mfg. Co., 4525 N. Euclid Ave., St. Louis, Mo.) Wrought steel, riveted, caulked, and welded. pt 32 **A1**

Mueller Steel Furnace (L. J. Mueller Furnace Co., 339 S. 2 St., Milwaukee, Wis.) Wrought steel, riveted, and welded. pt 32 **A1**

Do not use oil firing with cast iron furnaces, nor with steel furnaces unless lined with refractory material. pt 32

Superior (Richardson & Boynton Co.) Cast iron. pt 32 **B1**

Royal (Hart & Crouse Co., Utica, N. Y.) Cast iron. pt 32 **B1**

Mueller Cast Iron Furnaces (L. J. Mueller Co.) pt 32 **B1**

References

How to Improve the Hot-Air Furnace—Bu. of Mines Tech. Paper 208, by Charles Whiting Baker. 5c from Supt. of Docs. 20 pp. Washington: Dept. of the Interior, 1918.

Investigation of Warm-Air Furnaces and Heating Systems—The Research Residence, Part IV—Eng. Exp. Sta. Bul. 189, by Arthur C. Willard, Alonzo P. Kratz, Vincent S. Day. 60c. 116 pp., illus. Urbana: Univ. of Illinois, 1929.

INSULATION OF WARM AIR DUCTS

Insulation of warm air ducts is unnecessary except where ducts pass through unexcavated portions of basements, cold outside walls, or are laid in trenches, where a double duct is desirable. pt 32

Two thicknesses of asbestos air cell insulation are most economical. pt 32

The common practice of pasting asbestos paper "insulation" on hot air ducts, far from insulating them, increases the heat loss; indeed, it is not until 8 layers of 12-lb paper are put on that heat loss is again *reduced to that of the bare pipe.* pt 32

SHEET METAL FOR WARM AIR HEATING, AND VENTILATING DUCTS

Ordinary I. C. tin (tinned sheet iron) and galvanized iron are best suited for both gravity and fan systems. To prevent vibration noise, connections to and from fans should be made with canvas and not with metal. Sheet metal between fan and furnace should be twice as heavy as balance of duct work, because the area of the duct at this point is usually the greatest in the system and requires additional bracing to prevent vibration and "bellying" due to air pressure. Sheet metal casings of furnaces should be double and should be baffled to assure distribution of air over heater. (pt 31) Baffles should be placed on the delivery side of fan, between fan and furnace, or in furnace casing, to direct the air over the heater toward top and sides, otherwise all air is blown directly against that part of heater directly in front of fan outlet, usually the ashpit section. Some furnaces are now equipped with baffles in the casing. pt 32

The claims made for various alloys for ducts, more expensive than plain galvanized steel or iron, are questionable except under unusually corrosive conditions. g 32

REGISTERS AND GRILLES

Registers and grilles with more than one damper should not be used, as one-damper registers are more effective in regulating and directing air flow. The old type "louvred" dampers are more expensive and not nearly so efficient as the modern designs; due to the shape of the "louvred" type, eddy currents are set up which block the air flow. For economy, grilles should have a free area of at least 70% of that of the duct. pt 32

Registers in floors, even cold air returns, have been found undesirable. They are unsanitary, catching dust and dirt, are frequently covered over by rugs or furniture, and by directing heat upward do not accomplish as even a distribution as wall registers. One of the chief handicaps, both from a practical and esthetic standpoint, of the old warm air systems was the use of floor registers. pt 32

BOILERS AND FIRING APPLIANCES

CAST IRON COAL BURNING BOILERS

Boiler manufacturers usually have a line of several types and shapes for use with different fuels. The kind of coal to be used is an important consideration in selecting a boiler (see *Fuels,* col. 1). "Nominal" boiler ratings as given in catalogs are misleading and are never to be relied on. Some manufacturers list a "guaranteed" rating in addition to the "nominal" rating. The "guaranteed" rating, though still far from technically sound, is *safer* than the absurd "nominal" rating. Even a boiler of "guaranteed" rating must be selected with care, and the rating in square feet of "direct standing cast-iron radiation" must be equal to or greater than the total square feet of such radiation (radiating surface) in the whole plant, *plus* from 25 to 50% additional (50% is safer), plus 3 sq ft for each gallon of hot water tank capacity if a heating coil for hot water supply system is installed in the fire box or if the water is heated indirectly (via steam or hot water from the heating boiler). This computation can be made from any boiler company's catalog if the purchaser knows the amount of radiation in his job and the number of gallons of hot water required per day. pt 32

Richmond Radiator Co. (1480 Broadway, New York City) pt 32 **A1**

Pierce, Butler & Pierce Mfg. Corp. (41 E. 42 St., New York City) pt 32 **A1**

Ideal Round (American Radiator Co., 40 W. 40 St., New York City) pt 32 **A1**

Hercules (Sears, Roebuck & Co., Chicago) Round and square. pt 32 **A1**

Redflash (American Radiator Co., New York City) pt 32

Boilers with only one top section over fire pot are uneconomical. (Too little flue surface.) See that manufacturers guarantee their boilers to deliver their rated capacities economically. See that a definite written guarantee covering workmanship, material, and *capacity* of boiler is supplied with boiler. Do not be misled by gaudy sheet metal

A — *Recommended* | B — *Intermediate* | C — *Not Recommended*

Mills (H. B. Smith Co., Westfield, Mass.) pt 32 AA2
Royal (Hart & Crouse Co., Utica, N. Y.) pt 32 A2
covers and dressed up outside appearance. (See *Pipe and Boiler Insulation*, col. 16.) pt 32
Weil-McLain Co. (641 W. Lake St., Chicago) pt 32 B2
National (National Radiator Corp., Johnstown, Pa.) pt 32 B2
International Heater Co. (Utica, N. Y.) pt 32 B2

STEEL BOILERS

In hot water and steam systems, steel boilers are preferable to cast iron boilers. They respond more quickly with any fuel. With oil they are more efficient and safer. In small sizes their initial cost is slightly higher than that of equivalent cast iron boilers; in large sizes, lower. pt 32

Fitzgibbons Boiler Co. (570 Seventh Ave., New York City) pt 32 A1
Johnston Bros., Inc. (Ferrysburg, Mich.) pt 32 A1
Kewanee Boiler Corp. (Kewanee, Ill.) pt 32 A1
American Radiator Co. (40 W. 40 St., New York City) pt 32 A2
Thermo Service Boiler (Thermo Service, Inc., 101 Park Ave., New York City) pt 32 A3
Heggie-Simplex Co. (Joliet, Ill.) pt 32 B1
Pacific Steel Boiler Corp. (First National Bank Bldg., Detroit, Mich.) pt 32 B1
Triple Duty Boiler (Bass Foundry & Machine Co., Fort Wayne, Ind.) pt 32 B3

MECHANICAL COAL STOKERS

Mechanical stokers for burning the smaller sizes of coal at high efficiency have been placed on the market for use in domestic heating plants. The two main selling points for such stokers were: (1) the saving which might be made through the use of smaller (and formerly cheaper) coal; (2) the saving of manual labor in firing. The saving in coal price can no longer be taken for granted, and in fact total cost—that is, investment plus operation—may well exceed costs of other firing methods. pt 32

The cost of a stoker must be apportioned over its life (not over ten years), with the interest on the investment added, and the total must be less than the amount saved in fuel to be worth while. For instance, a stoker costing $400 would have to save more than $80 per year to effect any economy. (The $80 consists of $40 amortization, $24 interest at 6%, and $16 for electricity. There may also be service and repair costs of $10 to $25 per year.) If sufficient tonnage is not used, the stoker will not represent an economical investment, and even with a large tonnage there will be no saving through the use of a mechanical stoker unless the small sizes of coal are purchasable at a price very much below that for larger sizes. There has been an increase of about 80% in the cost of the smaller sizes of coal since the arrival of the stoker and blower devices on the domestic market. pt 32

The manual labor is reduced as stokers are adaptable to thermostatic control and require less frequent firing than do hand-fired furnaces. Mechanical troubles, however, may be greater. pt 32

Stokers with dumping grates are preferable to those which require the removal of ash in the form of clinker through the firedoors. Ascertain the minimum size of coal the stoker will burn, and whether it will burn the cheapest grade of coal you can buy in your locality, since the saving can only be made in the price of the coal. The lower the fire below the top of the firebox, the greater the efficiency; hence, a pit is usually required. Determine beforehand the amount of electric current the stoker will consume, as this may be appreciable. Some stoker dealers can make a fair estimate of the amount of electricity their stokers consume, but as rates vary in communities, dealers often use factory figures which were taken from localities where rates were much lower. Few dealers make fair estimates or take the trouble to obtain them from experience with their own local installations, unless specifically requested to obtain authentic data by prospective purchasers. To make such request and to insist on having the answer in the form of a written guarantee of maximum power requirements is necessary. pt 32

Electric-Furnace-Man (Domestic Stoker Co., 7 Dey St., New York City) For anthracite only. pt 32 A1
Motorstoker (Motorstoker Corp., 250 Park Ave., New York City) pt 32 A2
H & H Stoker (Holcomb & Hoke Mfg. Co., 1545 Van Buren, Indianapolis, Ind.) pt 32 A2
Detroit Junior (Detroit Stoker Co., Detroit, Mich.) Ram not well fitting, noisy. pt 32
Iron Fireman (Iron Fireman Mfg. Co., Portland, Ore.) Gas generated in worm housing carried into firebox in tube judged to be too small. Replacement cost for parts high. Servicing not thought satisfactory. pt 32
Riddell (Riddell Stoker Co., Frederick, Md.) pt 32 B2
Fire-King (Fire-King Stoker Co., 44 S. Capitol Ave., Indianapolis, Ind.) pt 32 B2
Combustioneer (Combustioneer, Inc., Goshen, Ind.) pt 32 B2

MAGAZINE-FEED BOILERS

Magazine feed boilers (for either steam or hot water) designed for buckwheat coal have the advantage of requiring less attention than the ordinary hand-feed type, and the lower cost of fuel may offset the higher initial cost. Ascertain the cost of fuel before purchasing. Savings will be closely equal to the difference in cost of fuel, as magazine-feed boilers will consume approximately the same quantity as the ordinary boiler. Much cheaper than boiler and stoker in first and sometimes in operating costs, for *small* buildings. If proper boiler is already installed, it is cheaper to install stoker as an auxiliary than to purchase and install entire new magazine-feed boiler. pt 32

Spencer Heater Co. (Williamsport, Pa.) pt 32 A1
Molby Boiler Co. (420 Lexington Ave., New York City) pt 32 A2
Newport Boiler Co. (529 S. Franklin St., Chicago) pt 32 A2
American Radiator Co. (40 W. 40 St., New York City) pt 32 B2
Weil-McLain Co. (641 W. Lake St., Chicago) pt 32 B2

OIL BURNING BOILERS

Ample heating surface is essential in an oil-burning boiler—at least one square foot of heating surface to each 14 sq ft of total equivalent direct radiation of connected load. Boilers designed to burn coal operate at a lower efficiency with oil. pt 32

Costs of heating with oil depend to a large extent upon the efficiency of the boiler (its ability to absorb the maximum possible amount of the heat released in burning the oil) and with No. 1 furnace oil at 9c per gal, the cost of heat should be less than with coal at $14 per ton, when the oil-burning boiler operates at an efficiency of over 75%. pt 32

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

A *Recommended* | B *Intermediate* | C *Not Recommended*

Ideal (American Radiator Co., 40 W. 40 St., New York City) Cast iron; round; should be 4 sections or over when used with rotary type burner. pt 32 **A1**

Mills (H. B. Smith Co., Westfield, Mass.) Oil burning type, cast iron. pt 32 **A1**

Johnston Bros., Inc. (Ferrysburg, Mich.) OB series. Steel; vertical tubes; cleaning difficult. pt 32 **A2**

Ideal Red Flash (American Radiator Co.) pt 32 **C1**

National (rectangular type) pt 32

Pierce (rectangular type) pt 32

Monitor Boiler (Monitor Bi-Loop Radiator Co., Lancaster, Pa.) Steel, with copper coils; difficult to clean. **C3**

Cast iron boilers with short travel for the combustion gases and small heating surface are not fitted for economical operation with oil. pt 32

Bryan Steam Corp. (Peru, Ind.) Copper tube boiler; difficult to clean. pt 32 **B2**

OIL BURNERS

Proper installation and servicing, both dependent on the reliability and experience of the dealer, are particularly important factors if comparatively satisfactory and economical operation of an oil burner is to be assured. Dealer and service policies of course vary widely in different cities. Investigate general and financial reliability of dealer, number of installations in your vicinity, kind of service furnished and annual cost of such service, and availability and uniformity of oil of grade required for the burner. Remember that any period of "free" service is not free but paid for by purchaser in the original price of burner. Dealers with three or four years of successful operation with one make of burner can usually be relied upon to continue in business; changes in management and business policies have, however, in some cases, been disadvantageous to previous purchasers. At the time of purchase, obtain three years' guaranteed service on burner even though at additional cost. Stipulate in contract that the purchaser is permitted to buy certain major replacement parts at stated prices. Service contract should include the checking of all safety devices and ignition system, and adjustment and cleaning of burner at regular and frequent intervals, contractor to replace any parts of burner or heating system which may be damaged by "puffs" or explosions caused by failure of safety devices or by delayed ignition. Boiler rooms must be well ventilated either by a permanently opened window directly to the outside or, if in the center of a building, by positive gravity or forced ventilation. Serious explosions have resulted through lack of sufficient and continuous air supply. pt 32

For some burners, standard replacement parts can be purchased at prices well below those for parts made especially by manufacturers of widely advertised burners for their own products. Investigate whether burner you intend to purchase can be serviced with such parts, and whether dealer with whom you are establishing relations can sell you such parts. pt 32

Do not buy burners which have not been approved for safety by the National Board of Fire Underwriters and do not bear the Underwriters' Laboratories label. In the case of oil burners, particularly, improper installation increases fire hazard considerably. Proper chimneys and flues are especially important in this respect. pt 32 + cr 32

In comparing cost of oil heating with other fuels consider the following which must be added to the cost of fuel consumed annually:

Depreciation (average life not over 10 years; maybe much less) 10%
Interest on investment 6%
Cost of ignition (gas or electricity) and motor .....$25 per season
Service Charges .....$15—$25 per season pt 32

A *Recommended* | B *Intermediate* | C *Not Recommended*

For comparison of fuel costs see col. 6.

Consumers planning to rely upon oil as a fuel should bear in mind the fact that present prices for oil are in some cases below cost of production, and that higher prices are likely to prevail in the future. pt 32

Cost of operation will depend as much upon the efficiency of the heating system and boiler or furnace as upon the efficiency of the burner. Burners for installation in present boilers should have a flame of the same general shape as that of the firepot of the boiler in which they are installed: rotary centrifugal type for round or square boilers and gun type for longitudinal boilers; however, with proper adjustment some burners may be fitted to any shape firepot. pt 32

Experience with rotary centrifugal burners has indicated that they are best suited for use in round or square boilers, preferably round, as they apply the heat to the base of the water leg of the boiler (bottom of water section directly above ashpit section) and a great deal of heat is transmitted by conduction through the metal sides of the boiler. Some of the heat is applied by convection (the hot gases passing through the upper passages of the boiler). Less heat is applied through radiation from this type of burner, as many makes burn with a bluish flame. The gun type (pressure or mechanically atomizing), on the other hand, causes an intense orange suspended or diffused flame. The rotary type does not work as efficiently under heavy load as the gun type and is not recommended for loads requiring over 4 gallons of oil per hour, although manufacturers claim it to have worked at higher loads. Even the very high speed types do not do a very good job of breaking up oil heavier than No. 1 (38-40° Baumé) and although some (notably *ABC*) are represented to burn No. 2 oil, many owners go to the No. 1 (about 20 to 25% more per gal in cost) after the first season. The usual dealer statement is "of course these burners are designed for, and will burn No. 2 oil, but the lighter oil is better and cleaner." This is the same tactic as is used with cars designed to require premium gasoline. pt 32

Positive electrical ignition has not been perfected for rotary type burners. Spark type ignition on gun type burners is more satisfactory. pt 32

Where quiet operation is a prime requisite the rotary type burners will be found satisfactory. In isolated locations, and where the electric power is apt to fail for periods of more than an hour or two, this type of burner is not desirable, as it is difficult to build a wood or coal fire on top of it without harming the burner and sufficient draft can hardly be obtained without breaking up and removing the refractory bottom of the combustion chamber. These burners do not have a mechanical air supply; they depend only upon the stack draft which should be controlled by a balancing device to maintain even combustion. pt 32

The mechanical atomizing gun type has a cup nozzle revolving in such a way as to break the oil into a spray. Oil pump and nozzle are directly operated from the same motor at very high speed. This type of burner is extensively used for industrial purposes and in marine boilers. U. S. Navy destroyers are equipped with this type. In small units it is usually more expensive than other types. pt 32

Pressure atomizing gun types use oil at high pressures through a small orifice with regulated supply of air delivered around oil by a fan nozzle. pt 32

Gun type oil burners direct the flame into a brick combustion chamber which is built in the ashpit section of the boiler; are not dependent upon stack for draft except to carry off products of combustion. Both gun types use heavier oils and atomize these very efficiently. As installations are outside the boiler an emergency fire, in case of failure of the burner, may be made with solid fuels without injury to the burner. Oil burners themselves are easily removed and when so removed, grates may be reinstalled by removing two courses of fire brick. pt 32

Do not install oil burners in cast iron warm air furnaces, particularly if fans are used in forcing air through the heating system. pt 32

Do not believe sales talk arguing that oil burners put an end to all heating troubles (many burners increase them greatly); or that remote rooms, now difficult to heat, will be more comfortable; or that the burner can be installed and forgotten. Such expectations are never realized. pt 32

Avoid (for house heating use) oil burners using steam, compressed air, or hot plates for atomizing oil. The first two are apt to be inefficient and noisy and the last will clog from

A *Recommended* B *Intermediate* C *Not Recommended*

soot unless used with uniform light distillates or kerosene; further, they require a very tight flue and carefully balanced draft. pt 32

All burners make some noise; this can be reduced by proper insulation. It is not sufficient merely to set the burner on a cork or felt base; it must be entirely isolated from direct rigid contact with boiler or piping of heating system, as these, when touching the burner mechanism, will transmit sound throughout the entire system. g 30

Direct current motor and any type of burner using electrical ignition will cause noisy interference with radio; the latter difficulty being one which occurs only at the moment of ignition. pt 32

Insist on a protective clause in sales contract guaranteeing against objectionable noise and radio interference, and providing for removal of burner, reinstallation of old equipment, refund to purchaser of payment already made, and purchaser's release from all further financial obligation should installation not be satisfactory: purchaser or his representative to be sole judge of satisfactory performance. g 30

None of the oil burners at present on the market can be considered wholly satisfactory. They must rather be regarded as still in an experimental stage. (pt 32) CR has, however, listed the following makes on the basis of what the market offers—not what an ideal market would supply—judging on probable mechanical and design efficiency and on installation experience.

Ballard (Arthur H. Ballard, Inc., 535 Commonwealth Ave., Boston) Mechanical draft, pressure atomizing. 3 years' guarantee and service. No. 2 oil. pt 32 **A1**

United States (Lassen & Bissell, Inc., 252 Asylum St., Hartford, Conn.) Rotary centrifugal atomizing. 4 year guarantee; service period optional with dealers. No. 2 oil. pt 32 **A1**

Silent Automatic (Timken-Detroit Co., 100 Clark Ave., Detroit, Mich.) Rotary centrifugal atomizing. One year guarantee, one year service. No. 1 oil. pt 32 **A1**

Electrol (Electrol, Inc., 170 Dorcas St., St. Louis, Mo.) Mechanical draft, pressure atomizing. One year guarantee; service period optional with dealers. No. 2 oil. pt 32 **A2**

Johnson (S. T. Johnson Co., 940 Arlington Ave., Oakland, Calif.) Mechanical draft, mechanical atomizing. One year guarantee. No. 2 oil and heavier. pt 32 **A2**

PetrO Model LD (Petroleum Heat and Power Co., Stamford, Conn.) Mechanical draft, mechanical atomizing. One year guarantee, one year service. No. 2 oil. pt 32 **A2**

Flexible Flame (Gilbert & Barker Mfg. Co., Springfield, Mass.) Mechanical draft, pressure atomizing. No. 2 oil. pt 32 **A2**

Nokol Model G (Petroleum Heat & Power Co.) Mechanical draft, pressure atomizing. No. 2 oil. pt 32 **A2**

Buy no oil burners sold ready for purchaser's installation. Successful oil burner installation requires previous study of the particular heating problem and existing equipment. pt 32

Kleen Heet (Winslow Boiler & Eng. Co., Chicago) Servicing not considered adequate. pt 30-32

Nokol Model L (Petroleum Heat & Power Co.) Pot type. pt 32

Oilomatic. Poor service and installations from dealers in some localities. Many explosions due to delayed ignition on old models. Sales ethics and methods unfavorably reported. pt 32

Hardinge (Hardinge Bros., Inc., Chicago) Excellent burner but complicated. Service difficult to obtain in some sections. Large turnover in dealers. pt 32

Cary System (Cary Mfg. Co., Waupaca, Wis.) Hot air furnaces. It is claimed that this system, including tube economizer, will heat, humidify, ventilate, and cool. pt 32

A B C (Automatic Burner Corp., 1823 Carroll Ave., Chicago) Rotary centrifugal atomizing. Nos. 1 & 2 oil. pt 32 **B1**

Torridheat (Cleveland Steel Products Corp., 7306 Madison Ave., Cleveland, Ohio) Rotary centrifugal atomizing. No. 1 oil. pt 32 **B1**

Quiet May (May Oil Burner Corp., 3500 E. Biddle St., Baltimore, Md.) Mechanical draft, pressure atomizing. No. 2 oil. pt 32 **B2**

McIlvaine (McIlvaine Burner Corp., 6 N. Michigan Ave., Chicago) Has flame which automatically adjusts to varying heat-loads—a highly desirable feature; but judged mechanically too complicated and cumbersome to be efficient. pt 32 **B3**

OIL BURNER AND BOILER COMBINATIONS

Combinations of complete boilers and oil burners have been placed on the market during 1931. Such units are usually far more efficient than the *average installation of oil burner combined with a coal fired type heating boiler* but are more expensive and are difficult to clean. They are well worth considering in connection with a new house if oil burner is desired but in event of failure of oil burner or electricity, another fuel such as wood or coal cannot be used. Oil burner service on this type unit should include frequent cleaning of boiler tubes or coils. pt 32

PetrO Automatic Boiler (Petroleum Heat & Power Co., Stamford, Conn.) pt 32 **B3**

Bryan (Bryan Steam Corp., Peru, Ind.) pt 32 **B3**

References

The Domestic Oil Burner—U. S. Dept. of Agric. Circ. 405, by Arthur H. Senner. 10c from Supt. of Docs. 29 pp., illus. Washington: U. S. Dept. of Agric., 1930.

List of Inspected Gas, Oil, and Miscellaneous Appliances, by Underwriters' Laboratories. Free. 132 pp. New York: National Board of Fire Underwriters, 1931. Supplement free. 38 pp. 1932.

GAS FIRED BOILERS

Heating boilers designed for use with natural or manufactured gas are built to operate for both hot water and steam heating systems. In comparison with the cost of other fuels, heating with gas may be considered a luxury, unless natural gas containing 1,100 or more heat units (Btu) per cu ft is available at from 50c to 60c per 1,000 cu ft; or manufactured gas containing 550 to 600 heat units (Btu) per cu ft is available at from 30c to 35c per 1,000 cu ft. pt 32

On gas boilers look for the label of the National Board of Fire Underwriters and of the American Gas Association, which are assurance that the boiler has met with the safety requirements of these organizations, but, no matter what the sales talk says, are *not* to be interpreted as a mark of quality or economy in operation. pt 32

In many localities a vigorous campaign is being conducted by gas companies to promote the use of gas as a house-heating fuel, and gas burning boilers are offered at attractive terms. Prospective purchasers of gas-fired boilers, especially when dealing with local gas companies, should request written and responsibly signed estimates of fuel consumption based on a mild season, an average season, and a severe season. These can be readily computed and supplied by the company from temperature data from the U. S. Weather Bureau over the past 50 years. Temperature changes are difficult to predict, hence averages for three types of seasons

A *Recommended* | B *Intermediate* | C *Not Recommended*

over a 50-year period are necessary for fair accuracy. In estimating, the heating season should be considered to cover the months of October to May inclusive and in some sections an even longer period. Purchases of gas heating equipment based on costs for mild seasons, and heating budgets based on such estimates, may result, during a severe season, in a very burdensome heating cost without the possibility of going on a more economical basis by returning to a cheaper fuel. Gas companies naturally cut off the fuel supply if bills are not promptly paid. Estimates of probable gas consumption should not be accepted without written, legally tight assurance that all gas consumed above the estimated amount will be furnished without cost to the consumer, and with the further provision that, in the event of one season's operation and failure to meet the guaranteed estimate, the gas boiler will be removed, the old equipment restored and all payments for gas boiler will be refunded, at the option of the purchaser. An accurate thermostat, preferably a clock thermostat which will lower temperatures at night, should be used with gas-fired boilers to insure economy. Do not carry temperatures of over 70° F during the day or lower than 60° F at night for greatest economy. To maintain a temperature of 75° F, fuel consumption will be increased 15 to 20%. pt 32

Gas piping systems in many cities have been installed without thought of future demands caused by house heating, and present mains are inadequate to supply sufficient gas in very cold weather unless either their size or the pressure at which the gas is delivered to the appliance is increased. Increasing gas pressures is, for the gas company, a profit-making means of delivering more gas, but means a great *loss* to the consumer unless his other appliances, such as gas stoves and water heaters, are adjusted for the higher pressure. The heating value, or number of heat units per cu ft of gas, and the pressure at which it shall be delivered to the consumer are regulated by law in many cities, such law being administered by the public utilities commission or similarly designated branch of state or municipal government, whose function it is to see that set standards of quality and pressure are constantly maintained. All causes for complaints, not adjusted by the gas company, arising through high or low pressures or poor quality should be referred to such commission, the gas company being advised of your intention to do so. If several taxpayers do it, results may be looked for in the few cases where the commissions are not futile and ineffective bodies. In general, public utilities dislike having cases brought to the commission for adjudication. pt 32

Gas appliances are much more safely bought of a local gas company than of department and hardware stores or mail order houses. The latter now sell a few appliances approved by Underwriters and A. G. A. pt 32

Local service is essential, as gas boilers do need attention and parts of control mechanisms occasionally fail. Boilers should be thoroughly cleaned once a year. Gas companies frequently perform all necessary service free of cost and are available upon call day or night for service work. The cost of service, when charged for, should be considered in purchasing. pt 32

"Many persons suffer discomfort and ill-health in the form of lassitude, languor, headache, and nausea without suspecting the cause to be carbon monoxide arising from the improper functioning or improper use of their gas appliances. Much of this could be avoided if every year before cold weather arrived a competent gas man were engaged to inspect the appliances, make necessary repairs, clean dirt and lint that has accumulated in the burners during the year, and adjust the burners so that good combustion is attained." u 28

Boilers listed are complete including burners and all necessary and required safety, gas regulating, and temperature controls.

A *Recommended* | B *Intermediate* | C *Not Recommended*

Mueller (L. J. Mueller Furnace Co., 339 S. 2 St., Milwaukee, Wis.) pt 32 **A1**

B-Line (B-Line Boiler Co., E. 131 St. & Taft Ave., Cleveland, Ohio) pt 32 **A1**

Basmor (Bastian-Morley Co., 300 Truesdell Ave., La Porte, Ind.) Sold through Crane Co. branches. pt 32 **A1**

Bryant (Bryant Heater & Mfg. Co., 17825 St. Clair Ave., Cleveland, Ohio) pt 32 **A2**

Hook (Hook Heater Co., Pittsburgh, Pa.) pt 32 **A2**

Ideal (American Radiator Co., 40 W. 40 St., New York City) pt 32 **B1**

Bryan (Bryan Steam Corp., Peru, Ind.) Copper tube boiler. pt 32 **B3**

CONVERSION GAS BURNERS

Conversion gas burners, to be used in connection with heating boilers and furnaces designed for coal, are not efficient; when equipped with necessary safety and temperature controls they are expensive. Look for label of American Gas Association and possibly also that of National Board of Fire Underwriters as assurance of safety in design of appliance but not as any sort of guarantee of efficiency or low operating cost. Baffles installed in flue passages of some coal-type heating boilers have increased efficiency to a slight degree, but blocking flue passages is a potential source of danger and in some cases may cause combustion gases to leak into basement. Burners with mechanical air-supply and mixing devices are complicated and require servicing. Some burners have an electric blower which consumes electricity; this cost must be added to the fuel bill. In the long run, complete boiler and burner combinations are less expensive, due to decreased installation and operating costs. (See *Gas Fired Boilers,* col. 26) pt 32

FURNACE BLOWERS

Small blowers may be advantageously employed in hand-fired furnaces in place of expensive mechanical stoker installations. In addition to burning smaller and cheaper grades of coal, they offer the advantage of thermostatic control, and though the firing periods are shorter, the initial cost and rate of depreciation are only about ⅓ as much as for a stoker. The preferred type of small blower has a damper for control of air supply. More elaborate blowers with necessary equipment may be too high in price for advantages gained. pt 32

Blowers should not be used in hot air furnaces unless such furnaces are absolutely gas tight. Only a steel furnace will be gas tight; cast iron furnaces are made in sections which open up at the joints through expansion and contraction of the metal, as it is heated and cooled. There is a very grave danger of leakage of carbon monoxide, which might be aggravated by a device such as a blower, in building up a slight over-pressure in the fire box which would force the gas into the circulating air space of the casing. There is even greater danger in the use of a furnace blower in connection with a system where a fan is used for forced circulation of the air. pt 32

American Blower Corp. (6001 Russell St., Detroit, Mich.) pt 32

Clarage Fan Co. (Kalamazoo, Mich.) pt 32

Buffalo Forge Co. (465 Broadway, Buffalo, N. Y.) pt 32

B. F. Sturtevant Co., Inc. (16 Damon St., Hyde Park, Boston) pt 32

A *Recommended* | B *Intermediate* | C *Not Recommended*

BOILER COMPOUNDS

Most of the commercial boiler compounds are useful, but none of them can be used successfully without a knowledge of the composition of the local water, and all are much more expensive than non-proprietary chemicals. Consult local water supply authorities for general advice or specific recommendations, and ask for more detailed technical advice from U. S. Bureau of Standards. (cr 32) If you insist on a proprietary method or formula for water treatment, consult only such manufacturers of boiler compounds as maintain water examination services and employ qualified chemists to examine the water and prescribe treatment. There is no universal compound which can be used with entire success without an accurate apportionment of the compound to the scale-forming material in the water. g 28

U. S. Navy Specifications for one grade of boiler compound call for the following constituents:

Sodium carbonate, anhydrous 76%
Trisodium phosphate 10%
Starch 1%
In addition sufficient dry extract of hemlock, oak, or chestnut bark to yield 2% of tannic acid. Remainder to be water, and only such impurities as are common to the ingredients. Materials to be finely powdered and intimately mixed. g 30

Washing soda. u 30

Sodium silicate and boiler compounds depending for their effectiveness on sodium silicate. pt 32

Mogul Ever Clean Boiler Process (North American Fibre Products Co., Cleveland, Ohio) cr 32

Thermolcolloids (Continental Asbestos & Refining Co., New York City) pts 32

Soot Remover for Boiler Passes

Karbo Kleen (Stafford Chemical Co., Amherst, Mass.) pts 32

Walters' Carbon Scale Remover (Walters Specialty Mfg. Co., 6153 Delmar Blvd., St. Louis, Mo.) cr 32

Reference

The Treatment of Water for Boiler Use—Letter Circular 254. Free. 18 pp. Washington: U. S. Bu. Stan., 1928.

TEMPERATURE CONTROLS

Temperature controls are necessary for economical operating of heating systems using gas or oil fuel. With coal or other solid fuel they are desirable for comfort and convenience, but hardly justifiable economically unless large quantities of fuel are used. A single thermostat operating directly upon an oil or gas burner is not satisfactory for uniform temperature control unless the rooms in the building are compactly arranged and the location of the thermostat is such as to represent accurately the temperature of the rest of the structure. For large houses with many exposures, or spread out in several wings, several thermostats are required, operating for separate zones, as one location may be affected by heat of the sun during part of day while another side of the building is in the shade or cooled by wind. To compensate for greater exposure than that applying to a single thermostat in a given location, the only possibility is to carry higher temperatures throughout the building, thus causing waste of heat and discomfort in some parts. pt 32

General Electric (General Electric Co., Schenectady, N. Y.) High voltage type. pt 32 **A1**

Minneapolis-Honeywell (Minneapolis-Honeywell Regulator Co., 2709 Fourth Ave., Minneapolis, Minn.) With clock $50 extra; low voltage type. pt 32 **A1**

Mercoid (American Radiator Co., New York City) High voltage type; not regarded as accurate. pt 32

A *Recommended* | B *Intermediate* | C *Not Recommended*

Sylphon Regitherm (Fulton Sylphon Co., Knoxville, Tenn.) Mechanical. pt 31 **A1**

Barber-Colman Co. (229 Loomis St., Rockford, Ill.) Electric. pt 32 **A2**

Johnson Service Co. (507 E. Michigan, Milwaukee, Wis.) Pneumatic. pt 31 **A3**

National Regulator Co. (2323 N. Knox Ave., Chicago) Pneumatic. pt 30 **A3**

Automatic and individual room controls on radiator valves are beyond the means of the average consumer, requiring extensive service and being expensive to operate. For large two-pipe steam and vapor systems individual radiator temperature control valves are economical from an operating standpoint, but first cost (about $15—$20 per radiator) is prohibitive except in very large buildings. When controls are to be used, electric controls are usually the most satisfactory type for dwellings, the low voltage system usually being more accurate than that operating at high voltage directly off the lighting circuit. pt 32

Modustat (Minneapolis-Honeywell Regulator Co., 2709 Fourth Ave., S., Minneapolis, Minn.) pt 32 **A3**

Regitherm (Fulton Sylphon Co., Knoxville, Tenn.) pt 32 **A3**

Trane Co., (La Crosse, Wis.) pt 32 **B2**

Thermotrol (Sterling Engineering Co., 3738 N. Holton St., Milwaukee, Wis.) pt 32 **B3**

DAMPER REGULATORS

Automatic damper regulators which open check drafts, and ashpit dampers to maintain a certain temperature or pressure at the boiler, are regularly furnished with coal burning boilers, and their use will materially aid operation and help efficient combustion if they are properly installed. Inexpensive clock attachments may be adapted to such regulators to open or close dampers at a predetermined hour. pt 31

Electrically operated thermostatic (temperature-actuated) damper-operating mechanisms do not as a rule give sufficiently accurate temperature control or save enough fuel to justify their cost. They usually cost over $60 installed, without clock device. pt 32

ELECTRIC RADIATORS AND HEATERS

Electric heating with present prevailing rates is an expensive luxury. For occasional small space heating, bathrooms, etc., and in very mild climates, it may be used. The convection type heater (similar to a hot water radiator in principle) is more effective and less expensive in operation than the radiant type heater. Some of the convection type electric heaters impart heat to the air by means of extended surface (finned) metal elements which are directly heated to temperatures below the boiling point of water; others employ a high-boiling-point liquid in an extended surface type finned tube radiator, the liquid being heated by an immersion type electric heater inserted in the radiator. pt 32

Convection Type

Chelva Electric Heater (Chelva Heat, Inc., 56 Earl St., Newark, N. J.) $55 to $95 with thermostatic control, available in sizes equivalent to 9 to 32 sq ft steam radiation. pt 32

Duct (Duct Electrical Heater Corp., 114 Liberty St., New York City) $75.50 with thermostatic control; equivalent to 36 sq ft steam radiation. pt 32

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

A *Recommended* B *Intermediate* C *Not Recommended*

Radiant Type

Cozy Glow (Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.) pt 30

Hotpoint (Edison General Electric Appliance Co., 5600 W. Taylor St., Chicago) pt 29

Universal Reflection Heater (Landers, Frary & Clark, New Britain, Conn.) Well built. pt 30

Dominion Radiant Heater (Dominion Elec. Mfg. Co., Minneapolis, Minn.) Had several defects. pt 30

Forced Type

Thermador Heater (Hoffman Specialty Co., Waterbury, Conn.) Electric heating unit and fan; cannot be connected to ordinary house circuit as large power is required. pt 30

GAS ROOM HEATERS

Gas room heaters, radiant, and enclosed or convection types, should be used only where inflammable vapors are not present. On gas room heaters look for label of the National Board of Fire Underwriters for safety. Heaters having *enclosed* burners are less likely to cause the ignition of draperies or clothing than those with open flames. Since air for combustion of gas is taken from the room and products of combustion are discharged into it from most gas heaters, a small room will become oppressively stuffy and even dangerous to health or life in a short time. Properly designed flue connections attached to flues installed in accordance with the Underwriters' Code reduce the possibility of vitiation of air, asphyxiation, and the formation, as may occasionally occur, of explosive mixtures within buildings, especially in small rooms. Gas heaters without flue connection are a great source of danger in rooms where there are small children. Gas heaters for use in garages must be indirect, that is, must have separate air intake and vent connections to a tightly enclosed combustion chamber so that no open flame comes in contact with or is exposed to the air in the garage. Do not of course do any cleaning with gasoline or naphtha in a room in which there operates a gas radiator or stove of any kind. pts 29 + pt 32

Economic (J. B. Slattery & Bros., Inc., 171 Wallabout St., Brooklyn, N. Y.) p 29 AA

Super Radiant (Wheeling Corrugating Co., Wheeling, W. Va.) p 29 AA

Humphrey Electric Radiant Heater (General Gas Light Co., 301 Water St., Kalamazoo, Mich.) pt 30 A2

Clow (James B. Clow & Sons Co., 201 N. Talman Ave., Chicago) pt 30 A2

Superior Gas Steam Radiator Co. (Los Angeles, Calif.) pt 32 A2

Garage Heater

Scientific Heater (Scientific Heater Co., Builders' Exch. Bldg., Cleveland, Ohio) Model "F." Indirect heater with flue. pt 32 AA2

AIR CONDITIONING SYSTEMS

The consumer should not be misled by the name "Air Conditioning System" as applied to certain assemblies of equipment consisting of a furnace, a fan, filter, and an evaporative type humidifier, since it is quite apparent that such a system is a forced circulation warm (hot) air system with an accessory humidifier. A true "air conditioning" system may be defined as a system which will develop and maintain the temperature, humidity, and cleanliness of air to suit a given purpose, and, to accomplish this under varying weather conditions, the apparatus must be capable of adding to and removing the moisture content of the air as required. The term "air conditioning" has evidently been eagerly seized upon by many manufacturers to give new stimulus to the sale of warm air heating equipment, much of which is not new, either in design or principle of operation. pt 32

Representations as to cooling and health benefits of warm air systems by manufacturers and dealers are mostly exaggerations and should be almost completely discounted by prospective purchasers, who should rather view such systems as types of heating systems competing in price with good hot water and steam systems. Dealers with no previous experience even in an allied field are posing as "experts" and so representing themselves to the consumer, after no more training than at most a trip to the maker's factory, more likely mainly to have impressed them than to have taught them anything. Some manufacturers have been making and installing forced circulation warm air heating equipment for several years and have developed this to include air washers which, though chiefly used for adding humidity (accurately maintained humidity depends on controls which are expensive), have been built of sufficient capacity to be used for cooling if naturally or artificially cooled water is made available from wells or a refrigerating plant. Cooling in connection with air systems through the use of washers or pipe coils carrying cold water or brine, or through direct expansion of refrigerant[1] is not as yet within the price range, either in first cost or operation, of the average home owner, except where large quantities of naturally cold water as a cooling medium are available at low cost. pt 32

The following recommended listings are of apparatus which has been successfully used. Complete systems will cost from 10 to 15% more than vapor heating systems without cooling features. pt 32

Climator (L. G. Mueller Furnace Co., 339 S. 2 St., Milwaukee, Wis.) For use with gas-, coal- or oil-fired furnaces. Can, with additional equipment, be adapted for cooling. pt 32 A1

Dualator (Bryant Heater & Mfg. Co., 17825 St. Clair Ave., Cleveland, Ohio) Air heated indirectly by coil from steam boilers; fired by any fuel. pt 32 A2

Weathermaker (Carrier-Lyle Corp., 850 Frelinghuysen Ave., Newark, N. J.) Gas- or oil-fired furnaces. pt 32 A3

Holland Air Conditioning Unit (Holland Furnace Co., Holland, Mich.) Advertising and high pressure sales talk lead one to believe that this unit in a single size (advertised at $235 plus installation costs) will cool and control the humidity in any size space. This unit will not cool the house or reduce the humidity unless cold water is supplied to it (water must be colder than the average city water), and it seems doubtful whether the small spray washer used will handle sufficient water to do much cooling. Holland Co.'s recommended installation uses air from basement with return ducts from upper rooms connecting into basement (not connecting to unit). This may be a source of potential danger in case of carbon monoxide or gas leakage from water heaters or furnaces while these are in operation. pt 32

HUMIDIFIERS

The cost of almost all humidifiers is exorbitant for the limited results obtained. Manufacturers have added immensely to prices to cover the cost of elaborate sales talks on health and to capitalize the comparative novelty of their particular contrivances. Electrically operated, mechanically atomizing humidifiers are expensive and require frequent filling. Most of them only hold two gallons of water, whereas the average house requires from 12 to 15 gals per day. Automatic humidifiers of the evaporative type, using cast iron or copper

[1] The direct expansion system is dangerous, as refrigerant gas in event of a leak will spread throughout a building.

A *Recommended* B *Intermediate* C *Not Recommended*

finned type sections, and with or without fans, give good results, but are very expensive, particularly when equipped with elaborate cabinets. They are not usable or effective with hot water heating systems. Successful humidifying depends to a large extent on the use of accurate automatic controls; otherwise gross over-humidification may result in severe weather, and under-humidification in mild weather. Moreover, the controls must be adjusted from time to time to compensate for weather changes. Do not install humidifiers in or near outside walls; this will result in local condensation on cold surface and cause streaking. Electric humidifiers and other types requiring frequent manual filling will probably find their way into the attic or storeroom after their novelty has worn off. pt 32

The best conditions for comfort are obtained with a temperature of 68° F at a relative humidity of 50%, although even with a competent humidifying system, this is not always obtainable because of loss of moisture by condensation on windows and walls. Lower humidity (10—15%) requires overheating of rooms (to 76—78° F) for comfort (in the sense of perception of temperature as right or suitable) equivalent to that given by the 68° F, 50% humidity condition. At these high temperatures, evaporation takes place rapidly from the mucous membranes of nose and throat, with consequent discomfort and added susceptibility to colds. It is far better to keep the temperature lower, which, with the same *amount* of moisture in the air, raises the *relative* humidity (percentage of saturation) slightly, but reduces discomfort due to excess evaporation of body moisture to a considerable extent. pt 32

Disregard claims that a saving in fuel can be made with lower temperatures and higher humidity achieved through the use of humidifying apparatus; tests have shown that more fuel is needed to evaporate the large quantities of water required than is saved by keeping the house at a lower temperature. pt 32

All humidifiers work to a certain degree but the only three considered simple, effective, and reasonably priced are the first three listed as *Recommended*. pt 32

Zephyr (Zephyr Washed Air Co., 2240 N. Racine Ave., Chicago) Spray type. pt 32 **A1**

Aqualator (Wilcolator Co., 17 Nevada St., Newark, N. J.) Spray type. pt 32 **A1**

Shenandoah (Shenandoah Mfg. Co., Harrisonburg, Va.) Fan and spray type with automatic control. pt 32 **A1**

Doherty-Brehm (Crane Co., 836 S. Michigan Ave., Chicago) Evaporative type, steam. pt 32 **A3**

Ideal Cascade (American Radiator Co., 40 W. 40 St., New York City) Evaporative type, steam. pt 32 **A3**

Any humidifier which is not readily accessible for cleaning is sure to clog and become a useless dust and dirt catcher.

Floor type units with register outlets in floor soon become choked with dust and dirt. pt 32

Trane (Trane Co., Lacrosse, Wis.) Evaporative convection type. Concealed type is apt to streak walls. pt 32 **B1**

Gilbert (Gilbert Mfg. Co., New Haven, Conn.) Electric type, requires frequent filling. pt 32 **B2**

Lewis (Lewis Corp., Minneapolis, Minn.) Fan type. Concealed model; is apt to streak walls. pt 32 **B3**

Airite (Airite Corp., 83 Murray St., New York City) Electric type. pt 32 **B3**

Aquazone (Corozone Co., Cleveland, Ohio) Electric type, small water capacity. pt 32 **B3**

A *Recommended* B *Intermediate* C *Not Recommended*

Radiator Pans

Radiator pans or pans built into radiator covers are *not* effective in increasing humidity to the desired point. Any humidity is better than none, but to increase the humidity appreciably, several radiator pans or several covers equipped with pans are required in each room. They require constant care and are apt to become dirty and cause bad odors if any organic substance gets into pan. pt 32

Air Washer Type, Warm Air Systems

An air washer for a warm air system consists of a spray chamber containing a number of nozzles spraying water; a fan pulls the air through this chamber. On the outgoing side of the washer is a metal baffle which acts as an extractor to remove surplus water and prevents water from splashing beyond the washer. An air washer with humidity controls is the best available apparatus for the purpose of humidifying with a warm air system but is *still in the luxury class, as are almost all automatic humidifiers on the market today.* pt 32

American Blower Corp., (6001 Russell St., Detroit, Mich.) pt 32 **A1**

L. J. Mueller Furnace Co. (339 S. 2 St., Milwaukee, Wis.) pt 32 **A1**

Clarage Fan Co. (Kalamazoo, Mich.) pt 32 **A2**

Buffalo Forge Co. (465 Broadway, Buffalo, N. Y.) pt 32 **A3**

The pan type of humidifier must have an evaporative capacity up to 12 gallons of water per day to have an appreciable effect in the average small house. pt 32

References

Humidification for Residences—Eng. Exp. Sta. Bul. 230, by Alonzo P. Kratz. 20c. 30 pp., illus. Urbana: Univ. of Ill., 1931.

Humidity in House Heating: The Cause and Control of Air Dryness in House Heating—Dominion Fuel Board No. 12, by E. S. Martindale. Free. 38 pp., illus. Ottawa, Canada: Natural Resources Intelligence Service, Dept. of the Interior, 1930.

Operating a Home-Heating Plant—Farmers' Bul. 1194, by A. M. Daniels. 5c from Supt. of Docs. 17 pp., illus. Washington: U. S. Dept. of Agric., 1928. See especially "Relative Humidity," pp. 13-17.

MISCELLANEOUS VENTILATING DEVICES

Small centrifugal fan ventilating and sound proofing units containing accessible and replaceable filters are helpful in ventilating rooms in dusty locations and in shutting out street noises coming through open windows. pt 32

Airgard (American Air Filter Co., 215 Central Ave., Louisville, Ky.) Small unit, about the size of a small radio set, designed to fit on a window sill or radiator under a window. The window is opened about two inches to admit air to the unit; the sides of the window opening extending beyond the air intake in back of the unit are closed with a sheet metal strip made for the purpose. The filtering material is efficient, inexpensive, and easily renewed. pt 32 **AA**

Protectovent (Staynew Filter Corp., 2 Leighton Ave., Rochester, N. Y.) Sizes 150 to 1000 cu ft air per minute. Same general type as *Airgard*. Good filter, somewhat difficult to remove. pt 32 **A2**

Stoppollen Air Filter (Davies Air Filter Co., 39 W. 32 St., New York City) Approved by A. M. A. for use in hay fever. m 30

Corozone (The Corozone Co., Cleveland, Ohio) This and other expensive pieces of apparatus for generating ozone are not recommended. According to the statement of an able physicist-subscriber, "Ozone is not only not beneficial, but actually exceedingly destructive to human tissues." (pts 30) "The use of ozone in garages is inadvisable. There has been no sound scientific work brought forward to show that there is any place whatever for ozone in problems of ventilation" (m 29) other than the destruction of odors. pt 30

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

LIGHTING

ELECTRIC LIGHTING

INCANDESCENT LAMPS

CR lamp tests. The following listings are based upon tests for CR, just completed.

Nilco (Sylvania Division, Hygrade-Sylvania Corp., Emporium, Pa.) Ranked first in overall economy, giving most light units per total expenditure involved in (a) the initial purchase of the lamp, plus (b) supply of current for its operation. Ranked second in length of life. This lamp affords only ½% better performance than the *Mazda* below. cr 32 **A1**

Mazda (Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.) A very close second in overall economy of operation; ranked fourth in length of life. cr 32 **A2**

Arcturus (Arcturus Radio Tube Co., 720 Frelinghuysen Ave., Newark, N. J.) Highest of four in cost of operation, fourth in lighting efficiency, first in length of life. One of ten test bulbs exploded, shooting a part of the bulb over 7 ft from the socket—an incident involving danger of blinding the lamp user or lacerations or infections from slivers of glass embedded in the face or scalp. cr 32 **C3**

Note: Lamp explosions probably occur in all makes. A more common type of failure which has been observed by a member of CR's staff (in *Mazda* lamps) is an internal explosion which does not rupture the bulb as a whole but punctures it in a few places with an alarming (but probably not, normally, dangerous) discharge of bits of molten metal. cr 32

Hi-Glo (Sears, Roebuck & Co., Chicago) Third in overall economy of operation, equal to the best (*Nilco*) in length of life. cr 32 **B3**

Ten samples each of the above four makes of inside frosted 40-watt tungsten lamps were tested, 3 burning base up, 4 base down, 3 horizontally. Complete report of findings and computations may be obtained by subscribers as a loan at a charge of $5, representing a $1 service charge plus $4 returnable deposit to cover the cost of replacing the report should it be lost. The data include: light output per watt electrical input, cost of operation, and total light produced per dollar invested in lamp and energy—which measures, as nearly as any single figure can, what one gets for one's dollar in purchase and operation of a lamp. Judgment of the importance of lamp efficiency can be made from the fact that most of the lamps on test consumed from $2 to $5 worth of electrical energy at 7c per kwh during their entire life. cr 32

These tests were computed for a 7c rate for electricity, which is not far from a mean for the U. S. At a 3½c per kwh average rate for electricity the order of merit of the above lamps would be the same as above. At the high rate of 12c on the other hand, the rating of the best three lamps would be in the order *Mazda, Nilco, Hi-Glo.*

Note that of the two recommended lamps and the third, intermediate lamp, the maximum difference in cost of light per dollar expended is quite small, 3.5%, which is not far from the probable error of the determinations plus a factor due to the variability of any maker's lamps with different sampling and at different times, so that for practical purposes it might be justifiable to consider the Sears, Roebuck *Hi-Glo* as comparable with *Nilco* and *Mazda.* But note that this close uniformity of product is characteristic only of electric lamps of good makes, and applies to almost nothing else that is manufactured.

We have information without test data from a technical expert regarding the following bulbs:

Champion (Consolidated Electric Lamp Co., Danvers, Mass.) Has passed government requirements and is licensed under the patents of the monopoly producer. (pt 29) Large sizes reported to break due to heat. pt 32

Hygrade (Hygrade Lamp Co., Salem, Mass.) pt 29

Any large user of incandescent lamps should of course purchase under specifications (Federal Specifications W-L-101, 5c from Supt. of Docs., and W-L-101 1932 Supplement, 5c from Supt. of Docs.), and make payment contingent upon samples properly passing technical acceptance tests.

The standard lamp is now the inside frosted, which has a smooth, easily cleaned exterior surface. Inside frosted lamps are not less efficient than the old clear lamps, as improvements in manufacture have increased efficiency more than enough to offset the 2% drop, due to the frosting, in the amount of light transmitted. u 32

Outside frosted lamps (rough to the finger nail) are inefficient and it is impossible to keep them clean enough to maintain them at anything near their initial lighting efficiency. cr 32

Imported lamp bulbs of all types are to be avoided, as there are no countries in which the American lamp is equalled or excelled as to overall economy of light production. This applies to flashlight bulbs as well, the imported varieties of which often have very short and variable life. Flashlight bulbs of even the best types are none too good in this respect. cr 32

The incandescent lamp market has for years been flooded with lamps of such low grade that, considering total outlay for lamp and current, the purchaser would be the loser even though each lamp were wrapped in a $2 bill. The main item in lamp purchase is not the purchase price but the cost of electrical energy consumed during the working life of the lamp in relation to the lamp's light yield. Refuse all lamps where maker's name or a familiar and reputable trade-mark is not clearly shown on the bulb.[1] cr 32

Among the sub-standard lamps are bulbs from Japan, of which sales in the U. S. of about 3 million a month are estimated. Their life is said to be half that of standard bulbs; their current consumption one-third more. Cost of lighting (price of lamp and current) is about 17 to 38% higher with Japanese lamps than with *standard* American. (u 32) Old lamp bulbs of reputable make are often "refilled" with inferior insides in "bootleg" shops. The difference is easily detected on close examination of such a lamp in comparison with a lamp known to be new and of reputable make, and any difference in appearance from standard is to be guarded against. (u + cr 32) A trade journal reports a test of such refilled tungsten lamps purchased at Woolworth's. One had a gross structural fault; the remaining three required on the average nearly 25% more current ($) to give substantially the same illumination as the regular 40-watt *Mazda*, yet these low grade lamps were considerably better than many sold in the variety chain stores. (u 29) . . . Carbon filament lamps are often substituted for the now familiar and almost universal tungsten lamp. The carbon filament is particularly inefficient and is easily distinguished, when the filament can be seen, by the fact that it glows with a more yellow and less brilliant color than the tungsten filament. An experienced user can distinguish the carbon filament even in frosted bulbs by the difference in color and concentration of light. Not only are such lamps grossly wasteful of electricity, but

[1] The producers of standard lamps in America will shortly begin to market electric lamp bulbs to sell for 10c, the customary retail price of the Japanese imports. The new bulbs will be designed for a life of 500 hrs and will be of inside frosted design similar to the standard lamp. No information is yet available on efficiency and one may well hesitate to purchase these new lamps until data on cost of operation and illuminating efficiency are available from unbiased sources. Lamp manufacturing costs can be easily judged by the fact that the lamp imports have been coming to America at an import value of 2c per lamp plus 4/10c duty. It is quite likely that the standard American lamps cost less rather than more than this to manufacture, since present lamp production (even testing) is on a nearly 100% machine operation basis, which should not only compete with but greatly excel in economy the less mechanized Japanese industry, in spite of the extremely low wages paid by the latter.

A *Recommended* B *Intermediate* C *Not Recommended*

their illuminating power falls off rapidly so that at the end of 500 hrs burning they will give less than one-half the light of the standard tungsten filament lamp after the same use. u + cr 32

New lamps are constantly being sold for which extreme claims are made of high efficiency or some other special value. It is possible to obtain almost *any* desired efficiency in use of current, but only at the cost of reduced life. Present lamp designs are based upon an assumed life of 1000 hrs; the salesman who makes the claims for superior efficiency will be far out of reach by the time his special lamp has come to the end of its two to three hundred hours' probable working life. Common devices for lending plausibility to the claims of special efficiency are: modification of the shape of the bulb (to a mushroom shape, for example) and great understatement of the wattage. The strange shape of the lamp accounts (to the gullible) for its supposedly increased efficiency, and the mislabeled wattage apparently confirms it. Simple measurements such as any high school or college teacher of physics or engineering can quickly make would disprove the claims. cr 32

Users of a large number of incandescent lamps will do well to have an electrician determine the actual mean voltage at the socket (it varies at different times of the day), as the selection of lamps for economy depends directly upon the actual (as opposed to the "rated") voltage on which they are used. A 10% deficiency in actual voltage below the nominal or labeled voltage of the lamp results in a 30% decrease in light *output* and approximately a 15% decrease in *efficiency* (energy assumed to cost 5c per kwh). Similarly, a 10% excess voltage increases illuminating *costs* by shortening the lamp life 70%, while increasing light *output* by nearly 40%. (u 30)

Major causes of incorrect voltage operation of lamps are: (1) Lamps transferred from one district to another without regard to change in rated voltage; such change may be as much as 10 volts. (2) Lamps frequently sold by dealers at an excessive voltage rating to increase lamp life, so meeting an occasional complaint by a customer that his lamps burn out too soon. Individual lamps of the best makes may fail at very short life; resulting complaints are based on the assumption that such failures are characteristic rather than exceptional. In selling such off-rating lamps the dealer heavily penalizes all those whose lamps receive normal treatment or for other reasons give the standard life performance. (3) Deficient voltage due to inadequate conductors. The voltage in the user's house and at the particular socket involved may, because of "line drop," be considerably below that intended to be delivered by the central station. Much house wiring is skimped by contractors to save copper, and this results in voltage drops which penalize the householder ever after in his lighting cost. Your lighting company engineers will tell you what your lamp socket voltage *should* be. Ask an engineer friend to see what it *is*. The line drop varies with the number of lamps burning or the number of appliances in use in the whole house, and test should therefore be made with the normal number of lamps and other devices operating. u + cr 32

NEW ULTRA-VIOLET LAMPS

There is a new type of ultra-violet-emitting lamp bulb similar to and capable (with certain modifications of fixtures, or the use of new and unwarrantably expensive fixtures) of being substituted for ordinary incandescent lamps in home or office lighting. No reliable information from unbiased non-commercial sources is yet available on the efficiency and economy of these lamps such as would justify any great weight being given by consumers to the strong claims made for them. (cr 32) Therapeutic benefits have not been established. m 32

OVERHEAD LIGHTING FIXTURES

Lamp fixtures should be simple in design, and the glass bowl should be just thick enough for the lamp filament, or on a frosted lamp, the bright central portion of the bulb, not to be distinguishable. The glass should be free from decorations or relief of any sort which would accumulate dust or introduce inequalities in light distribution. Indirect lighting fixtures on the whole require twice the electricity to achieve the same effective illumination intensity given by direct lighting fixtures. Indirect fixtures do diminish glare and in this way permit comparable reading efficiency to be obtained at a somewhat lower intensity of light. Reflectors on indirect fixtures may be either metal or glass; metal as a rule makes the lighting completely indirect, while glass makes it nearly so. (pt 31) It is an important economy, especially where the amount of light used is considerable, to keep reflectors and shades well and continuously cleaned. The great waste involved in diminished light transmission of dirty glass is seen in the discussion of window panes under *Daylight* below. u + pt 31

With respect to office, kitchen, and workroom illuminating fixtures, the proper sized diffusing globe for a 200-watt lamp is 14 in. diameter; for 300-watt, 16 in.; for 500-watt, 18 in. (both direct and "semi-indirect" fixtures). pt 31

Knapp Electric Co. (346 W. 34 St., New York City) Manufactures an excellent low priced droplight which diffuses the light well and does not cause glare. pt 30

Never buy electric fixtures (any kind) from house-to-house salesmen. Many shrewd tricks are carried out by such salesmen to convince the scientifically uninformed; e.g., in demonstrating the latest marvel in the field of lighting equipment it is often the practice to put a 110-volt lamp on a 120-volt circuit, giving highly impressive and allegedly far more efficient illumination, but cutting lamp life to one-third normal. Such salesmen often make the local lighting companies the unknowing sponsors of their fraudulent activities. pt 31

There are hundreds of different forms and types of lamp combinations and shade and reflector systems for which excessive and unwarranted claims, either for efficiency or the quality of light, are made. Demand proof for even the smallest claims and refuse to buy without proof. There are no known principles which can greatly improve or economize the use of electricity in lamps for purposes either of general lighting or illumination of desks or working space. cr 32

Royalite (Cherniak Mfg. Co., New York City) ad 31

PRIVATE ILLUMINATING PLANTS

CR has no information on private illuminating plants for country houses, and would be glad to receive information from technically informed and disinterested subscribers who have no commercial interest in the question, as to the advantages and disadvantages, costs of service, freedom from need for repair, etc., on small-sized isolated houselighting plants of makes and types with which they may have experience.

NATURAL AND ARTIFICIAL LIGHTING

DAYLIGHT

Window panes keep out a large proportion of visible light—from 12% for the best new, clean panes, to 70% for weathered, dirty panes—of the total which strikes the glass. Eighteen weeks' weather exposure of the pane will decrease light transmission 25 to 50% below the 65 to 88% transmission of the clean glass. Frequent cleaning of windows is therefore a matter of economy since the amount and cost of artificial illumination used during certain periods of the day

are directly related to the amount of daylight illumination available inside the room at these periods, viz., the marginal periods of early morning and twilight, where choice has to be made daily between artificial and natural illumination. ts 31

HOME AND OFFICE ILLUMINATION IN GENERAL

Amount. Illuminating engineers generally believe that more light than is now customarily used in offices and workrooms will bring definite economies in production. Likewise in the home more and better lighting will reduce fatigue and make household tasks easier. A well-known company making fine instruments (work whose precision requires good light) lights certain manufacturing and test sections to 35 footcandles, drafting rooms 30, offices 20 to 25 (compared with 10 to 12 units of lighting found in most manufacturing plants). For sewing on dark materials at least 25 footcandles illumination should be provided. (u 31) Local electric companies will often furnish without charge specialized testing facilities for making the necessary measurements of available light in office and shop; or write the National Lamp Works (405 Lexington Ave., New York City) either for advice or for bulletin No. 41-D (no charge). Since the local lighting company is often tied up with suppliers of fixtures and lamps, its advice is not always to be depended upon as unbiased. Its agents will tend to recommend higher lamp wattages than actually required. On the whole, however, their advice will be better than none, and persons not in a position to employ an independent illuminating engineer will do well to follow it. cr 32

SHADING

No incandescent lamp of the high efficiency tungsten type should be exposed continuously to the direct vision of a near observer; either its position or its shading should be such that light from the high intensity source cannot directly strike the eye, as the accommodation required to adjust the eye intermittently to such high levels of illumination causes definite visual strain and fatigue. For continuous writing, reading, or clerical work, a lamp should be so situated that, while its light is thrown upon the work, the lamp itself is beyond the periphery of vision. The use of unshielded high-wattage lamps common in window displays puts such an offense upon the eyes of passers-by that it should be prohibited by law. (u + cr 32) Direct reflection of light from working materials, particularly from anything glossy, as smooth calendered paper, is also a cause of eyestrain. "Spotty" illumination, where the intensity is high at one point and fades off sharply due to a lamp's being placed too close to the work or a lampshade's giving excessive localization of light, is also fatiguing because the eyes, when at work, are continually, though unconsciously, directed back and forth from brilliantly lighted zones into dimly lighted areas, and hence must make repeated accommodation under severe strain to the change in light intensity. More even illumination at a lower intensity is preferable to bright illumination concentrated on the immediate area of the work. For these reasons the usual desk lamp giving a concentrated zone of light of small area is most undesirable. u + cr 32

"Daylight" illumination. There are many lamps now being sold on the claim that they save a great proportion of electricity over other lamps, such claims usually being based upon supposed gains due to imitation of the color of daylight illumination. It is not possible to make lamps or fixtures to reproduce daylight except at a great *loss* of economy in use of electricity, a loss running to as much as 90%. Moreover, claims to the contrary notwithstanding, there is no definite advantage for general reading purposes in daylight-colored illumination. If such illumination is offered, demand of the maker (for you to refer to a scientist or engineer) a *quantitative* expression of the guaranteed approximation of the device to daylight in the form of a spectral emission curve, plus a statement of lumens light output per watt input, plus guaranteed operating life of the average lamp. This will stop the salesman and save you money. (cr 32) There is no means of *accurately* reproducing daylight with incandescent lamps. cr 32

Eastman Kodak Co. (Rochester, N. Y.) and Corning Glass Works (Corning, N. Y.) Produce light filters by use of which one may change *Mazda* lamp illumination into an approximation to daylight *coloring* of the light. pt 31

Macbeth Daylighting Co. (227 W. 17 St., New York City) Believed to make the best daylight *fixtures.* pt 31

Brady-Lite (Brady Mfg. Co.) ad 31

Blue bulbs, though sold as such, are not really, in any practical sense, "daylight" bulbs; they are 35% less efficient than clear glass or "inside frosted" standard lamp bulbs. They offer no advantage other than somewhat improved color discrimination except, as noted below, when used in places and at times involving *mixed* daylight and electric light. pt 31

Elaborate tests conducted in England indicated that at equal illumination intensity a group of office workers preferred "artificial daylight" for clerical work; there was a *slight* increase of output; likewise it was indicated that illumination giving a light distribution similar to that from a window was preferable to illumination from semi-indirect overhead fixtures. For mixed lighting, when both daylight and artificial light are operative at a given time and place, there appears to be an advantage, or at least a preference by users, for artificial lighting systems simulating the color of daylight. As a rough approximation, ordinary tungsten lamps may well be used for pure artificial lighting, while some form of modified "daylight" lamp may improve mixed daylight and artificial light; but in spite of a great deal of experimentation the difference in values or preferences of users is not great or of large physiological significance. ts 30

References

General Illumination Course (1931). Westinghouse Lighting Institute (Westinghouse Lamp Co.), Grand Central Palace, New York City. The material of this correspondence course is presented in a clear, simple, non-technical manner, but naturally not without bias favoring the lamp and lighting fixture industry. Assignment No. 11 of this course, on *Farm Lighting,* may be secured by farmers. Request for this should be addressed to the Commercial Engineering Dept., Westinghouse Lamp Co., Bloomfield, N. J. Other numbers in this series are not available to individual consumers but may be borrowed from public libraries, which can usually obtain a desired copy on request. The following give information useful to CR subscribers: No. 1, *Light Sources;* 2, *Incandescent Lamps;* 3, *Units of Light* (photometry); 4, *Principles of Light Control* (reflection, transmission, etc.); 5, *Interior Lighting Designs;* 6, *Industrial Lighting;* 7, *Commercial Lighting.*

FIRE EXTINGUISHERS

REFERENCES ON FIRES AND USE OF FIRST AID FIRE APPLIANCES

Special bulletin by Consumers' Research. Within about two months CR will issue a mimeographed or printed bulletin giving in considerably expanded form the material appearing in abstract below. Send address label and 10c in stamps if you want it.

A *Recommended* B *Intermediate* C *Not Recommended*

Approved Appliances for Fire Protection and Prevention. 77 pp. Boston: Associated Factory Mutual Fire Insurance Companies (184 High St.), 1931. Supplement, 8 pp., 1931.

Fire Safeguards for the Farm—Farmers' Bul. 1643. 5c from Supt. of Docs. 22 pp., illus. Washington: U. S. Dept. of Agric., 1930. Excellent brief statements of fire hazards, covering roofing materials, chimney construction, lining protection, stoves and furnaces, oil stoves, lamps, gasoline, storage of hay, and other important items.

First Aid Fire Appliances—Regulations of the National Board of Fire Underwriters . . . as recommended by the National Fire Protection Assn., effective October 15, 1931.[1] 78 pp., illus. Contains description of principles and practices in extinguishing small fires, and advice regarding the suitability, use, and maintenance of the various devices, including water pails.

First Aid Fire Extinguishers. 27 pp., illus. Boston: Associated Factory Mutual Fire Insurance Companies (184 High St.), 1930.

General Rules and Regulations, Ocean and Coastwise. Free. 293 pp. Washington: U. S. Dept. of Commerce, 1931. Contains lists of extinguishers tested at U. S. Bu. Stan. and approved for use under the supervision of the Steamboat Inspection Service. Supplement free. 15 pp., 1931.

List of Inspected Fire Protection Appliances.[1] 140 pp. Chicago: Underwriters' Laboratories (207 E. Ohio St.), 1931. Supplement, 15 pp., 1932.

Safe Use and Storage of Gasoline and Kerosene on the Farm —Farmers' Bul. 1678. 5c from Supt. of Docs. 14 pp., illus. Washington: U. S. Dept. of Agric., 1932. Prepared jointly by U. S. Dept. of Agric. and National Fire Protection Assn., this bulletin contains illustrated instructions and suggestions regarding extinguishers for gasoline and kerosene fires.

The Spontaneous Combustion of Hay—Tech. Bul. 141. 10c from Supt. of Docs. 39 pp., illus. Washington: U. S. Dept. of Agric., 1929.

The Story of the National Fire Protection Association and List of Its Publications. Single copy free. 12 pp. Boston: 1931. Contains names of authoritative publications on a wide variety of subjects related to fire prevention and fire protection.

Steamboat Inspection Service Bulletin. Monthly. Washington: U. S. Dept. of Com. Not generally useful to ultimate consumers.

Fire extinguishers are designed to control small fires in their first stages, usually the first five minutes. When a fire is small it can be stamped out, smothered with a rug, or put out with a pail of water. A fire alarm is more effectively given by the municipal fire alarm box than by telephone. Water pails are among the best extinguishers but have the disadvantage that, being useful for other purposes, they are often unavailable in a fire emergency. pt 32

The following discussion relates primarily to portable fire extinguishing appliances, mainly for household and similar use.

In certain shoe manufacturing plants 70% of 455 fires in a 5-year period were successfully put out with portable extinguishers, properly maintained, recharged, and used by instructed persons. (pt 32) Such instruction and systematized maintenance is most important; *otherwise money spent on extinguishers is likely to be wasted.* In recharging, manufacturer's instructions should be carefully followed. u 31

Uninformed and ill-directed attempts to extinguish a fire may be dangerous—e. g., water thrown on grease burning on a stove causes it to sputter violently. A burning pan of deep fat can usually be extinguished by placing a large metal cover over the pan; a fire in spilled grease on a stove can be put out with flour, baking soda, or sand, but not with soda-acid or other water-solution type of extinguisher (otherwise one of the most suitable kinds for home fires). pt 32

Fire prevention engineers consider that the city home owner had better leave all but the briefest endeavors at fire extinguishment to the fire department. Many country places are within a few miles of a fire dept. with a gasoline-driven pumping engine. In such cases a valuable safeguard for the owner of a country property is to provide a cistern of water from which the fire dept. pumper can draw for fire hose lines. If a pond or stream is available, special provision can be made for facilitating use of suction hose therein (see first reference at head of this article). pt 32

Fire protection engineers generally place extinguishers in three classifications:

1. Those which quench or cool (by water or water solution): soda-acid, foam (surface effect only), loaded stream (see below), calcium chloride, plain water, pump tanks, water pails, cask and pails units. Most effective on combustibles such as wood, paper, textiles, rubbish. t

2. Those which smother (as with a blanket of gas or foam): foam, carbon tetrachloride, carbon dioxide, dry chemical (gas type). Smothering type essential for putting out fires in open containers of flammable liquids. t

3. Those whose action is by catalysis: loaded stream (also has quenching effect). t

For fires among electrical equipment the following are suitable: carbon tetrachloride, carbon dioxide, dry chemical (gas pressure type). pt 32

For certain locations it is important that extinguisher should not freeze:

For freezing locations, such as unheated warehouses and farm buildings, use: calcium chloride[1], loaded stream[1], carbon dioxide, carbon tetrachloride[2]; dry chemical, water pails[3], pump tanks[3], cask and pails units[3]. pt 32

The following should not be used in buildings which are unheated or may be without heat for a period: soda-acid, foam, plain water. pt 32

A fire extinguisher *should not be bought on the basis of any sort of sales demonstration.* It is very easy to make any fire extinguisher, even of the inferior dry powder type, perform in a convincing and superior fashion by using it on a type of demonstration fire to which it is particularly adapted. Rather, an extinguisher should be selected which is listed in one of the references given above. The Steamboat Inspection Service, Department of Commerce, issues regular bulletins of approved fire protection appliances based on tests at the (otherwise) secretive and suppressive Bureau of Standards and available to shipping interests and buyers and sellers of equipment for ships and all manner of water craft. The practicability of the government's issuing to the public reports with respect to the goods it has tested and reported on for its own use is seen in this regularly published list of fire extinguishing appliances approved for use on private and commercial vessels coming under the jurisdiction of the Steamboat Inspection Service; yet the practicability of issuing

[1] Single copy available free from the National Fire Protection Assn., (60 Batterymarch St., Boston) or from the National Board of Fire Underwriters, (85 John St., New York City). Also available from most offices of stock company fire insurance *inspection and rating bureaus,* located in state capitals and principal cities of U. S.

[1] Safe for temperatures down to —40° F. pt 32
[2] Safe for temperatures down to —50° F. pt 32
[3] With non-freezing solutions. See first reference above.

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

such reports is frequently denied by defenders of the government's do-nothing policy in regard to the quality of commercial products. There is close agreement in the listings of approved fire extinguishers by the Steamboat Inspection Service and those of the Underwriters' Laboratories in Chicago, maintained by the *stock* fire insurance companies, and the Inspection Department of the Associated Factory Mutual Fire Insurance Companies in Boston. Underwriters' Laboratories test and list these devices, and affix a label as evidence of approval. cr + pt 32

Prices to buyers of individual extinguishers are high, but quotations are flexible and shopping around is useful. After choosing the *type* of extinguishers satisfactory for your purpose, specify an Underwriters' Laboratories labeled unit and buy on a price basis. pt 32

In the listings which follow, only the principal brand name of each manufacturer is shown, and the almost endless list of special brands made up for jobbers is necessarily omitted for lack of space. Demanding the Underwriters' label will insure reasonable adherence to standards. Practically all A listings were carefully selected for ultimate consumer purposes by a qualified engineer with special experience in fire prevention practice.

WATER PAILS AND CASK AND PAILS UNITS

Five substantial 12-qt capacity pails of fibre, galvanized iron, or steel, preferably with loosely fitted cover, are approximately as effective as one 2½-gal soda-acid extinguisher but have much more limited range. A 50-gal covered cask or barrel of water and three pails make a recommended unit. (See first reference above.) Suitable pails are obtainable from most good hardware stores or from the following makers: Dover Stamping & Mfg. Co. (385 Putnam Ave., Cambridge, Mass.); Reeves Mfg. Co. (Dover, Ohio). pt 32

SODA-ACID TYPE

For fires in ordinary combustibles (wood, paper, textiles, rubbish, etc.), of value wherever the quenching effect of the water solution may be employed, including greasy or oil-soaked floors, etc. *Not* to be used on live electrical equipment; not effective on fires in open containers of flammable liquids or greases, etc. u 31 + pt 32

Of this commonest, and, for its capacity, least expensive, type of extinguisher the principal size is 2½-gal. As a basis for shopping, price paid by the government at wholesale for 2½-gal soda-acid extinguishers is $5 on rigid quality specifications. 1¾ and 1½-gal sizes are made, and are advantageous for women users. Inversion of the extinguisher mixes sulphuric acid and a water solution of sodium bicarbonate, generating pressure to expel the liquid without further action by the operator. The quenching effect is due to the water and not the carbon dioxide gas. The solution must in general be considered harmful to fabrics on which it may fall. Not suitable for unheated rooms or buildings; the freezing point cannot be lowered by chemical additions. Recharging required at least once a year; inexpensively done, often by one's fire dept. pt 32

The following are all A (g 31 + pt 32) listings:

Alert, 2½-gal (American-La France & Foamite Corp., 100 E. La France St., Elmira, N. Y., and La France Fire Engine & Foamite, Ltd., Toronto, Ont., Canada)

Automatic, 2½-gal (Geo. W. Diener Mfg. Co., 400 N. Monticello Ave., Chicago), also a 1½-gal size

Badger's, 2½-gal, and *Badger's Pony*, 1¼-gal (Badger Fire Extinguisher Co., 962 Park Square Bldg., Boston)

Buffalo, 2½-gal, and *Junior Buffalo*, 1¼-gal (Buffalo Fire Appliance Corp., 44 Central Ave., Buffalo, N. Y.)

Columbia, 2½-gal (Columbia Fire Defense Corp., 174 Centre St., New York City)

Elkhart, 2½-gal (Elkhart Brass Mfg. Co., 1302 W. Beardsley Ave., Elkhart, Ind.)

Essanay, 2½-gal (Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J.)

First Aid, 2½-gal. (W. D. Allen Mfg. Co., 566 W. Lake St., Chicago)

Fyr-Fyter, 2½-gal (Fyr-Fyter Co., 221 Crane Ave., Dayton, Ohio)

Garth, 2½-gal (Garth Co., 26 Craig St., W., Montreal, Que., Canada), also a 1¼-gal size

Globe, 2½-gal (Globe Automatic Sprinkler Co., 2035 Washington Ave., Philadelphia)

Guardene, 2½-gal (Pyrene Mfg. Co., Newark, N. J., and Pyrene Mfg. Co. of Canada, Ltd., 1197 King St. W., Toronto, Ont., Canada)

National Standard, 2½-gal (Standard Extinguisher Co., 24 Binford St., Boston)

Phister, 2½-gal (Phister Mfg. Co., 9 St. and Broadway, Cincinnati, Ohio)

Queen, 2½-gal (Harker Mfg. Co., 121 W. 3 St., Cincinnati, Ohio)

Red Star, 2½-gal (General Mfg. Co., 4127 Forest Park Blvd., St. Louis, Mo.)

Security, 2½-gal (Knight & Thomas, Inc., 212 Summer St., Boston)

Standard, 2½-gal (Miller-Peerless Mfg. Co., 325 N. Curtis St., Chicago)

Stemfire, 2½-gal (made by Robinson Fire Apparatus Co. for Stempel Fire Extinguisher Mfg. Co., 4270 N. 20 St., St. Louis, Mo.), also a 1½-gal size

Underwriters, 2½-gal (Knight & Thomas, Inc.), also a 1¼-gal size

Vulcan, 2½-gal (Knight & Thomas, Inc.)

Woodhouse, 2½-gal (Woodhouse Mfg. Co., 156 Chambers St., New York City)

HAND-PUMP TANKS

For fires in ordinary combustibles (wood, paper, textiles, rubbish, etc.), of value wherever the quenching effect of water solutions may be employed. *Not* to be used on live electrical equipment nor on fires in open containers of flammable liquids. u 31 + pt 32

These are simply metal tanks arranged with a handle for carrying them to the fire and a pump by means of which a stream of water or non-freezing solution may be directed on the fire. The 5-gal size has an extinguishing capacity approximately equal only to that of a 2½-gal soda-acid extinguisher, since its action depends on pumping by the operator and since it must be set down and held in one place by the operator's foot while in use, which makes it less convenient for directing a stream on the fire from several directions in succession than is the case with extinguishers of the self-generated pressure type. Has a range of 30 to 40 ft, and there is some advantage in that it can be used intermittently, as an extinguisher can not. Can be refilled readily during use and is a good type for farms and country estates which have only a small supply of water available. On farms avoid its use as potato sprayer. pt 32

The following are all A (g 31 + pt 32) listings:

Accurate, 5-gal (Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J., and Pyrene Mfg. Co. of Canada, Ltd., 1197 King St. W., Toronto, Ont., Canada)

Alaskan, 2½-gal (General Mfg. Co., 4127 Forest Park Blvd., St. Louis, Mo.)

American-La France, 5-gal (American-La France & Foamite Corp., 100 E. La France St., Elmira, N. Y.)

Arrow, 5-gal (D. B. Smith & Co., Main St., Utica, N. Y.)

Buffalo, 2½ and 5-gal (Buffalo Fire Appliance Corp., 44 Central Ave., Buffalo, N. Y.)

Diener, 2½ and 5-gal (Geo. W. Diener Mfg. Co., 400 N. Monticello Ave., Chicago)

Duraguard, 5-gal (Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J.)

Fyr-Fyter, 2½ and 5-gal (Fyr-Fyter Co., 221 Crane Ave., Dayton, Ohio)

Miller, 2½ and 5-gal (Miller-Peerless Mfg. Co., 325 N. Curtis St., Chicago)

A *Recommended* B *Intermediate* C *Not Recommended*

CALCIUM CHLORIDE TYPE

A non-freezing type, for fires in ordinary combustibles. Not to be used on live electrical equipment; not effective on open containers of flammable liquids, but of value wherever the quenching effect of water solutions may be employed. Slightly more harmful to fabrics than plain water. The 2½-gal size is similar in appearance to the soda-acid type and of approximately equal extinguishing capacity. It is operated by being inverted and bumping on the ground or simply inverted, according to directions. This creates pressure by a reaction of chemicals in the appliance or releases pressure from a small cartridge of compressed carbon dioxide which expels the liquid, mainly, a solution of calcium chloride (non-freezing down to temperature of —40° F). Range, 30-40 ft. Considerably more expensive than the soda-acid, but a reliable type for unheated buildings. Manufacturer's own recharges must be used. pt 32

The following are all **A** (g 31 + pt 32) listings:

Arctic, 2½-gal (American-La France & Foamite Corp., 100 E. La France St., Elmira, N. Y., and La France Fire Engine & Foamite Ltd., Toronto, Ont., Canada)

Badger's, 2½-gal (Badger Fire Extinguisher Co., 962 Park Square Bldg., Boston)

Protex, 2½-gal (Knight & Thomas, Inc., 212 Summer St., Boston)

FOAM TYPE

Foam is very effective for use on fires in open vessels or containers for most flammable liquids, primarily because of its smothering effect. Foam does not penetrate as well as other water solutions but is effective where it may be used to coat the burning surface or where the fire may be beaten out with the force of the stream. It will effectively control most fires in ordinary combustibles, and for a given extinguisher size, foam appliances have fire-extinguishing effect practically equivalent to the soda-acid type. *Not* to be used on live electrical equipment. pt 32

In operating, extinguisher is inverted; this mixes a solution of aluminum sulphate with a solution of sodium bicarbonate and water to which a foaming agent, such as licorice extract, has been added. The mixing produces carbon dioxide gas, which furnishes the pressure to expel the contents as a foam (seven times volume of original solution) consisting of minute, tough bubbles of carbon dioxide. pt 32

Foam is especially effective for the protection of dip tanks of paint and certain other flammable liquids used in industrial processes and for gasoline and oil tanks. Its effectiveness as an all-round extinguisher is greatly overemphasized by salesmen; it is not reliable on light alcohols, acetates, acetones, ether, carbon bisulphide. Much depends on skill in use, and special instruction is necessary. Heavily discount evidence of demonstrations. The advantages of foam, except where there is a flammable liquid hazard, do not warrant its greater cost. The 2½-gal size standard unit is about equivalent to same size in soda-acid type. u 31 + pt 32

The 1¼ and 1½-gal sizes are advantageous for women users, and either of these is an especially good unit for the kitchen in dealing with stove fires in grease. Range, 30-40 ft; material damages fabrics somewhat. Manufacturer's own recharges must be used. pt 32

The following are all **A** (g 31 + pt 32) listings:

Alfoam, 2½-gal (American-La France & Foamite Corp., 100 E. La France St., Elmira, N. Y.)

Allen, 2½-gal (W. D. Allen Mfg. Co., 566 W. Lake St., Chicago)

Amdyco, 2½-gal (manufactured by Buffalo Fire Appliance Corp., Buffalo, N. Y., for Amdyco Corp., 100 E. 42 St., New York City)

Badger's, 2½-gal, and Badger's Pony Foam, 1¼-gal (Badger Fire Extinguisher Co., 962 Park Square Bldg., Boston)

Buffalo, 2½-gal (Buffalo Fire Appliance Corp., 44 Central Ave., Buffalo, N. Y.)

A *Recommended* B *Intermediate* C *Not Recommended*

Fastfoam, 2½-gal (Pyrene Mfg. Co., 560 Belmont Ave., Newark N. J.)

Floafoam, 2½-gal (General Mfg. Co., 4127 Forest Park Blvd., St. Louis, Mo.)

Foam Fyr-Fyter, 2½-gal (Fyr-Fyter Co., 221 Crane Ave., Dayton, Ohio)

Foamite 2½-gal (American-La France & Foamite Corp. and La France Fire Engine & Foamite, Ltd., Toronto, Ont., Canada) Also a 5-gal size.

Fomon, 2½-gal (American Fomon Co., Inc., Drexel Bldg., Philadelphia) Also a 1½-gal size.

Frothex, 2½-gal (Knight & Thomas, Inc., 212 Summer St., Boston)

Kontrol, 2½-gal (manufactured by Robinson Fire Apparatus Mfg. Co., St. Louis, Mo., for Stempel Fire Extinguisher Mfg. Co., 4270 N. 20 St., St. Louis, Mo.)

Miller-Peerless, 2½-gal (Miller-Peerless Mfg. Co., 325 N. Curtis St., Chicago)

Phomene, 2½-gal (Pyrene Mfg. Co., and Pyrene Mfg. Co., of Canada, Ltd., 1197 King St. W., Toronto, Ont., Canada)

Queen, 2½-gal (Harker Mfg. Co., 121 W. 3 St., Cincinnati, Ohio)

Stempel, 2½-gal (manufactured by Robinson Fire Apparatus Mfg. Co. for Stempel Fire Extinguisher Co.)

CARBON TETRACHLORIDE TYPE

The modified carbon tetrachloride used in these extinguishers is safe against freezing (down to temperatures of —50° F) and practically harmless to most materials, but involves danger in confined spaces or small unventilated rooms. The vapor produced is an anesthetic similar to chloroform. There is the possibility of the formation of poisonous gases (chlorine, hydrochloric acid, and phosgene) when used on fires developing high temperatures. For this reason the *Journal* of the A.M.A. says: "Its use in fire extinguishers, inside of buildings, constitutes a dubious practice." (m 31) On the other hand experienced fire protection engineers say that except in very rare cases there is little practical danger from the use of the smaller sizes of the extinguishers. u + cr 32

Ordinary or commercial carbon tetrachloride must not be used in fire extinguishers, as it may freeze at low temperatures (its freezing point is 9.4° F below zero); also it corrodes the mechanism of the extinguisher, which is a difficulty the extinguisher manufacturers have had to a serious extent, even with extinguisher liquids made under specifications for their purpose.[1] (g 30) *Ultimate* consumers should invariably purchase the liquid offered by the manufacturer of the extinguisher in which it is to be used, so that they may try to hold the manufacturer of the extinguisher responsible should the appliance corrode or otherwise fail in an emergency. A carbon tetrachloride extinguisher can and should be tested by discharging the contents periodically into a clean receptacle, from which they can be poured back into the extinguisher. This type is difficult to maintain, as the liquid is an effective dry-cleaner and may be stolen. Frequent inspection essential. u + cr 32

Common sizes: 1, 1¼, 1½ qt. Extinguishing capacity of these small units is less than that of the 2½-gal units of other types, but two 1-qt units in skilled hands are approximately equal to one 2½-gal foam unit on open pan of flammable liquid. Because of their low extinguishing capacity and maintenance difficulties, none of these extinguishers is rated higher than B (intermediate). Homes and institutions should not employ 1, 2, and 3-gal carbon tetrachloride units, which are recommended only for industrial applications. u 31 + pt 32

Extinguishers of the 1-qt size are the most practical with which to equip an automobile or small motor boat. pt 32

Units 1 gal in size or over, except for certain special industrial hazards. pt 32

The makes and types of the de-

[1] Such specifications when used by large consumers of extinguishers reduce its price approximately 50% below the customary price for the manufacturers' proprietary liquid.

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

A *Recommended* | B *Intermediate* | C *Not Recommended*

vice which have appeared and reappeared on the market over a period of many years, consisting of bottles, or globes, usually filled with carbon tetrachloride (the "hand-grenade" type of extinguisher). These have very small quantities of liquid, and when thrown at the fire are designed to break or spill their liquid all at once, whence complete vaporization is next to impossible even if the seat of the fire is reached. (pt 32) A considerable number of private[1] tests have been made on these devices with the following results:

1. Devices failed to break when thrown (or when dropped automatically by the operation of a fusible link, a feature of some of the most exploited makes stressed in sales literature and by high pressure salesmen). g 30

2. Thrown from the hand by inexperienced persons, the grenades seldom reached the seat of the fire. g 30

3. Had little or no effect on the fire (an apparent partial smothering occurred in some tests run on fires in small compartments, but repeating the tests *without* the devices produced the same effect, due to exhaustion by the fire of available oxygen). pt 32

4. Very small fires about 2 ft sq in area (flames not over 1 ft high) in oil-soaked waste could sometimes be put out if fires were built on concrete floor and grenades carefully thrown so as to break and project vapor over area of fire. In most cases the fire was not completely put out and reignition occurred. pt 32

These devices are vastly inferior to the recommended types. Their use has a dangerous effect as persons unfamiliar with their limitations obtain a false sense of security. Five elderly persons lost their lives in a fire in an institution which, according to the sales literature of the manufacturer, was protected by 114 of these so-called "automatic" extinguishers, the effect of which, if any, was not visible to the fire dept. The amount of money spent on these devices was far worse than wasted. (See Farmers' Bul. 1643, *Fire Safeguards for the Farm*, pp. 17-18, reference given above.) u+cr+ pt 32

Shur-Stop (International Fire Equipment Corp., Staten Island, N. Y.) pt 32

AutoFYRstop (Equipment Supply Corp., 11 W. 42 St., New York City) pt 32

All "bottle grenades."

[1]Government departments know all about the inefficiency of these devices and the gross public deception involved in their sale, but function to restrain them neither by obvious regulatory action nor by simple publication of the facts, easily expressible in a single mimeographed page of the hundred thousand or so issued annually to the press by government publicity bureaus. Such release, given wide publicity, would save millions in dollars to American consumers and hundreds of lives. cr 32

A *Recommended* | B *Intermediate* | C *Not Recommended*

The following **C** listings and other makes (not here given) have been offered free to clients of local insurance agents (usually acting through ignorance), or for prices much lower than those at which standard makes may be obtained. They are similar in appearance to standard 1-qt units but are equipped with an inferior pump of the bicycle tire type which, in addition to other defects, fails to pump the liquid when the stream is directed above the horizontal. pt 32

Tetrine pt 32

Firex pt 32

The most effective makes of this type project the extinguishing liquid on the fire in a relatively fine, thin stream, so that the liquid is almost completely vaporized, thus getting the benefit of practically all the smothering effect of the gas. The stream, whether pumped by hand or furnished by stored pressure from compressed air or other gas, may be quite accurately directed as well. pt 32

Badger's, 1 and 1½-qt (Badger Fire Extinguisher Co., 962 Park Square Bldg., Boston) pt 32

Dayton, 1 and 1½-qt (Manufactured by the Fyr-Fyter Co. for the Dayton Fire Extinguisher Co., 1300 E. 1 St., Dayton, Ohio) pt 32

Fire Gun, 1, 1¼ and 1½-qt (American-La France & Foamite Corp., 100 E. La France St., Elmira, N. Y., and La France Fire Engine & Foamite, Ltd., Toronto, Ont., Canada) pt 32

Fyr-Fyter, Super Model, 1 and 1½ qt (Fyr-Fyter Co., 221 Crane Ave., Dayton, Ohio) pt 32

The above, with minor improvements, is renamed:

New Super Fyr-Fyter, 1 qt (Fyr-Fyter Co.) pt 32

La France, 1-qt (American-La France & Foamite Corp. and La France Fire Engine & Foamite, Ltd.) pt 32

Niagara, 1 and 1½-qt (Buffalo Fire Appliance Corp., 44 Central Ave., Buffalo, N. Y.) pt 32

Pyrene, 1 and 1½-qt (Pyrene Mfg. Co., 560 Belmont Ave., Newark, N. J., and Pyrene Mfg. Co. of Canada, Ltd., 1197 King St. W., Toronto, Ont., Canada) pt 32

Stempel, 1 and 1½-qt (Stempel Fire Extinguisher Mfg. Co., 4270 N. 20 St., St. Louis, Mo.) pt 32

Stop-Fire, 1-qt stored pressure type (Stop-Fire, Inc., 621 E. 216 St., New York City) pt 32

CARBON DIOXIDE TYPE

This type of extinguisher is in common use in industrial plants. It is especially desirable for putting out certain types of fires where the smothering effect of the gas can be well used and where the kind or value of the materials concerned may involve some vital objection to the use of other methods of fire extinguishment. It is not, however, a universally applicable method. It has been successfully used for fires in

or around electrical equipment, for which it is especially effective; to extinguish flaming grease in a hotel kitchen, where even the food was not harmed by it; and with limited success in airplane and automobile fires. It is understood that this type is to a large extent replacing portable foam and carbon tetrachloride extinguishers on shipboard. This method is at a definite disadvantage with fires in the open air, where the gas is not confined, and is *not* suitable for cases where fire is likely to gain considerable headway and size before first-aid equipment can be brought to bear. If fire has been burning some time, water (when otherwise proper) should be used on account of danger of reignition through the high temperature of materials heated by the fire; carbon dioxide extinction alone may not be a secure safeguard in many types of hazard; e. g., in the case of a fire in a gas stove oven the fire started again five times until water was used *to cool the oven and contents below flash point.* A home gasoline fire similarly reignited. Carbon dioxide is exceedingly quick in its action, on account of which the danger of reignition is particularly great; it is *not* suitable for substances like soot or charcoal because of their special reignition hazard. Furniture and its padding and upholstery offer somewhat similar difficulties. pt 32

As to the hazard of its use to the operator, the gas is somewhat poisonous, and while it is a fact that the air in a room can still be breathed when the oxygen content is reduced to a point where it will not support combustion, there may be cases where in small rooms or closets the amount of carbon dioxide may rise to somewhat dangerous limits. This is thought not to be a serious hazard, in view of the short exposures to which the extinguisher operator would be subjected, and the device works particularly efficiently on such closely confined fires. *N. B.* The snow from the discharge should not be permitted to remain in contact with the skin. u 31 + pt + cr 32

This type of extinguisher needs no protection against freezing. The extinguisher should be weighed at least once a year or oftener to detect leakage or accidental loss of gas. Its successful use requires the possibility of close approach to the fire (within a maximum distance of eight feet). The smaller extinguishers discharge their contents very quickly and for this reason the operator must be skilled to work effectively. pt + cr 32

The following are all **A** (g 31 + pt 32) listings:

Alfite, 7½, 10, and 15 lb (American-La France & Foamite Corp., 100 E. La France St., Elmira, N. Y., and, except for 10 lb size, La France Fire Engine & Foamite, Ltd., Toronto, Ont., Canada)

Fyre-Freez, 4, 7½, 10, and 15 lb (Fyre Freez, Inc., 90 West St., New York City)

Fyrout, 7½, 10, and 15 lb (manufactured by Walter Kidde & Co. for Fyrout Carbon Dioxide Extinguisher Co., 6425 Hollywood Blvd., Los Angeles, Calif.)

Lux, 4, 7½, 10, and 15 lb (Walter Kidde & Co., 140 Cedar St., New York City)

LOADED STREAM TYPE

These extinguishers are similar in appearance to the older soda-acid and foam types and similar in method of use. They make use of a chemical extinguishing effect not as yet fully understood or explained, in addition to the cooling and quenching effect of the water solutions employed. pt 32

The solutions used are non-freezing down to temperatures of —40° F; and *Instant,* a 1¾-gal unit, will extinguish as much fire in ordinary combustibles as a 2½-gal soda-acid unit. The smaller size thus made possible is an advantage. pt 32

This type is operated by being inverted and bumped on the ground. In one make this punctures an acid bottle, permitting an acid to react chemically with a special non-freezing solution, creating pressure and expelling the liquid. In another, pressure is supplied by a carbon dioxide cartridge. The range is 30-40 ft. An alkali metal salt solution is used, having an effect on fires unlike other extinguishing agents. On fires in ordinary combustibles (wood, paper, textiles, rubbish, etc.) the stream extinguishes the flame rather suddenly and there is a pronounced "fireproofing" effect, materially retarding "flashback." Such extinguishers are effective on small fires in flammable liquids in open vessels, on floors, etc. There is no smothering vapor produced to blanket the fire, and the peculiar extinguishing effect (which is real, and definitely established) has not been as yet explained, except by an assumption that the solutions used affect the chemical processes of combustion by a negative catalyzing effect. u 31 + pt 32

Not to be used for fires in live electrical equipment. The solution is harmful to fabrics. Manufacturers' recharges must be used. pt 32

The following are all **A** (g 31 + pt 32) listings:

Instant, 1¾-gal (Fyr-Fyter Co., 221 Crane Ave., Dayton, Ohio; Fyr-Fyter Co. of Canada, Ltd., 1197 King St. W., Toronto, Ont., Canada)

Protexite, 2½-gal (Knight & Thomas, Inc., 212 Summer St., Boston) Has the greatest extinguishing capacity in ordinary fires of any type of 2½-gal unit.

Thermene, 1¾-gal (Marketed by Pyrene Mfg. Co. of Canada, Ltd., 1197 King St. W., Toronto, Ont., Canada)

PLAIN WATER TYPE

This is a recently developed type, likely to be widely manufactured, which has promise of superiority in some respects. Similar in appearance, size, and general effectiveness to the soda-acid type. No harmful chemicals are used. Instead, pressure to expel the extinguishing liquid (plain water) is provided by a small cartridge of carbon dioxide, a sealing disc of which is punctured when the extinguisher is inverted and bumped on the ground. *Not* recommended for fires in live electrical equipment; *not* suitable for use in unheated buildings. (Non-freezing extinguishers using the same principle are available. See *Calcium Chloride* and *Loaded Stream* Types above.) pt 32

Aqua-Lux, 2½-gal (Walter Kidde & Co., 140 Cedar St., New York City) pt 32

DRY POWDER EXTINGUISHERS

Sand or inert matter is an effective extinguishing agent. Pails of sand (dry and clean) are useful for small fires in flammable liquids and greases on floors, etc., and on low voltage electric apparatus (other than moving machinery). The fires must be small so they can be attacked at close range. pt 32

Small quantities of inert matter, or mixtures of bicarbonate of soda, coloring matter, and other materials, in powder form, in sheet metal tubes, and other containers, have been sold as "fire extinguishers" at various times and under a wide variety of names. (A small amount of carbon dioxide gas produced from the sodium bicarbonate by the heat of the fire adds slightly to the extinguishing effect.) The commonest type uses about 15 or 20c worth of materials in a unit which is sold for $3.50 to $5. These "extinguishers" are of such extremely limited value that their use is not recommended. If a specially treated bicarbonate of soda is not used, the powder may cake after a short period, and it is very common to find such appliances totally inoperative. They are dangerous because they engender a false sense of security. u 31 + pt + cr 32

A portable dry chemical device which has met the requirements of Underwriters' Laboratories, is a bona fide fire appliance. It is placed in intermediate column (B) below mainly because of newness and lack of fire experience to demonstrate its general dependability. It is a cylinder con-

taining specially treated bicarbonate of soda in dry powder form, and an inert compressed gas. Opening of a valve discharges a dust cloud of gas and powder, producing a smothering effect. It is applicable to the same uses as carbon dioxide extinguishers, being effective in smothering fires in open vessels of flammable liquids, safe to use on electrical fires, harmless to fabrics; may be kept in unheated locations. There is the same danger of reignition especially in fires of ordinary combustibles, because of a lack of mass-cooling effect. The extinguisher should be reweighed at least once a year or oftener to detect leakage or accidental loss of gas. pt 31

| Dry powder tubes and similar devices (see comment above). g 30

Du-Gas Dry Chemical Extinguisher, 20 lb (Du-Gas Fire Extinguisher Corp., 11 W. 42 St., New York City) pt 32

BUILDING MATERIALS

Prices given for building materials are intended merely to indicate a range. In the actual market, and especially under present conditions, prices may so fluctuate that our figures must not be held applicable to all sections of the country, or at a given time. For many commodities in this group the consumer is in a very good position to bargain by getting competitive bids from various manufacturers.

References

The magazines listed below give information both in technical language and in addition sometimes in such form that it is easily understood and usable by the layman. Our consultant believes that the magazines will prove more easily useful than will the books to a person without technical training who wishes to get general information about building materials. Most of the govt. pamphlets are more specialized in subject, and are probably the best introductory references a consumer can consult on a special subject.

See price list 72 of government publications. Free from Supt. of Docs., Washington.

American Architect. Monthly. $3 a year. New York: International Publications, 57 St. at 8th Ave.

Architects and Builders Handbook, by F. E. Kidder and H. Parker. 18th Edition. $8. 2400 pp., illus. New York: John Wiley & Sons, 1931.

Architectural Construction, by Walter C. Voss and Ralph Coolidge Henry. Vol. I. $20. 1266 pp., illus. New York: John Wiley & Sons, 1925.

The Architectural Forum. Monthly. $7 per year. Concord, N. H.: Rogers & Manson Corp., 10 Ferry St.

The Architectural Record. Monthly. $3 per year. New York: F. W. Dodge Co., 115 W. 40 St.

Architecture. Monthly. $3 per year. New York: Charles Scribner's Sons, 597 Fifth Ave.

The Better Homes Manual, edited by Blanche Halbert. $3. 781 pp., illus. Chicago: University of Chicago Press, 1931.

Care and Repair of the House—Building and Housing Publication BH15, by Vincent B. Phelan. 20c from Supt. of Docs. 121 pp., illus. Washington: U. S. Bu. Stan., 1931.

Circular 15. Free. Columbus: Ohio State University, 1928.

Effectiveness of Moisture-Excluding Coatings on Wood—Circ. No. 128, by George M. Hunt. 10c from Supt. of Docs. 28 pp., illus. Washington: U. S. Dept. of Agric., 1930.

Fifty Ways to Lower Home Building Costs, by Robert Taylor Jones. 10c. 9 pp., illus. New York: Architects' Small House Service Bureau, Inc.

Grade Marking of Lumber for the Consumers' Protection. 10c from Supt. of Docs. 14 pp., illus. Washington: U. S. Dept. of Commerce, 1928.

Handbook of Building Construction, by Hool and Johnson. 2 vol. $10. New York: McGraw-Hill Publishing Co., 1930.

House Design, Construction and Equipment (in preparation). $1.15. Washington: The President's Conference on Home Building and Home Ownership, 1932.

How to Judge a House. 10c from Supt. of Docs. 85 pp., illus. Washington: U. S. Dept. of Commerce, 1931.

How to Own Your Home—Building and Housing Publication BH17, by John M. Gries and James S. Taylor. 5c from Supt. of Docs. 26 pp. Washington: U. S. Bu. Stan., 1931.

Painting Plaster—Letter Circular 288. Free. 5 pp. Washington: U. S. Bu. Stan., 1930.

Pencil Points. Monthly. $3 per year. New York: Pencil Points Press, 419 Fourth Ave.

Pocket Guide to Good Construction. 25c. 47 pp., illus. New York: Architects' Small House Service Bureau, 1927.

Present Home Financing Methods—Building and Housing Publication BH12. 5c from Supt. of Docs. 22 pp. Washington: U. S. Bu. Stan., 1928.

Properties of Fiber Building Boards—Miscellaneous Publication, Bu. Stan., No. 132, by C. G. Weber, F. T. Carson, L. W. Snyder. 5c from Supt. of Docs. 13 pp., illus. Washington: U. S. Bu. Stan., 1931.

Recommended Minimum Requirements for Small Dwelling Construction—Building and Housing Publication BH1. 15c from Supt. of Docs. 108 pp., illus. Washington: U. S. Bu. Stan., 1922.

Six Steps in Building or Buying a Home. 10c. New York: American Construction Council, 1928.

Standards and Specifications for Building Materials—Letter Circular 323. Free. Washington: U. S. Bu. Stan.

A Study of the Heat Transmission of Building Materials—Bul. No. 102, by A. C. Willard and L. C. Lichty. 25c. 60 pp., illus. Urbana: Engineering Experiment Station, University of Illinois, 1917.

The Architects' Small House Service Bureau offers the service of practicing architects, including counsel, ready-to-use plans, specifications, working drawings, quantity surveys, complete details—at low cost—for the erection of homes up to and including six primary rooms. It is a limited dividend corporation with a small capital. Some pamphlets are available. The addresses of the regional divisions are: 101 Park Ave., New York City; 7 W. Madison St., Chicago; 333 N. Pennsylvania St., Indianapolis, Ind.; 1197 Stout St., Denver, Colo.; 194 Boylston St., Boston; 425 E. Wisconsin Ave., Milwaukee, Wis.; 721 Virginia St., Seattle, Wash.; 1210-A Chamber of Commerce Bldg., Pittsburgh, Pa.; 6174 Delmar Ave., St. Louis, Mo.; 1200 Second Ave. S., Minneapolis, Minn.; 230 Hanna Bldg., Cleveland, Ohio.

Architectural Service Bureau of The American Institute of Architects, The Octagon, Washington, D. C. Information from this bureau is not available except to members of the Institute, but subscribers who have architect friends may be able to have questions answered from the Service Bureau through their friends or through an architect consultant.

ROOFING

Choice of roofing is largely predetermined by the style of architecture. Within that limitation, however, the consumer should consider the following attributes: resistance to weathering (that is, durability), maintenance, fire resistance,

A *Recommended* B *Intermediate* C *Not Recommended*

and heat conductivity. Color is an important factor with respect to heat conductivity, white roofs being preferable to dark ones in hot climates, irrespective of roofing material. All roofs should be heat insulated. (See *Heat Insulating Materials, Col.* 56.) Unless otherwise stated, the materials here listed, if properly applied, are considered adequately water-tight. pt 32

ROLL ROOFING

This is the cheapest form of roofing, less satisfactory than flexible shingles in durability and good in resistance to spark or flying ember ignition, although less so than slate or tile. The material is felt made from rags and wood pulp and saturated with asphalt. This is the same material, in 100 ft rolls, of which flexible "asphalt" shingles are made. It comes in three weights—single and two- and three-ply, surfaced with slate granules or asphalt. The cost of laying this type of roofing, including labor and material, ranges from 9c to 13c per sq ft. pt 32

ARTIFICIAL SHINGLES

Artificial shingles and roll roofing are classified as A, B, and C by Underwriters' Laboratories in accordance with their fire resistance. Durability and cost are roughly proportionate to fire resistance rating. Asphalt and asbestos shingles are available in a wide variety of types. Having made his selection, the purchaser may safely specify roofing with Underwriters' Laboratories rating, and buy on a price basis. Manufacturers of roofing are listed in the *List of Inspected Fire Protection Appliances* (new edition annually), free from Underwriters' Laboratories, 207 E. Ohio St., Chicago, or from branch offices in principal cities.

Flexible type: The cheaper grades of artificial shingles are of the flexible type and are generally made of asphalt-saturated felt of varying thicknesses surfaced on the exposed face with small particles of slate. In weights lighter than Underwriters' Grade C likely to curl up at the corners; heavier weights are satisfactory as to wearing qualities. They are more fire-resistant than wood shingles, but less so than slate or tile roofing. Available either as single shingles or in strips of three or four shingles each. The latter form is cheaper in both initial cost and laying cost. pt 32

Artificial shingles of asphalt-saturated felt should be laid over a smooth sheathed surface, not nailed to lath. Such shingles are sometimes laid over an old wood shingled roof. This is done for the sake of economy but cannot be recommended. The cost of laying this type of roofing, including labor and material, will range from 10c to 13c per sq ft for strips in plain colors, in blended colors about 1c more; for separate shingles, 11c to 15c. pt 32

Rigid type: The more expensive grades of artificial shingles are rigid shingles made of asbestos fibre and Portland cement. They are made in thicknesses from ¼ in. up in various sizes and colors, some representing old weathered tile, and some surfaced with slate granules, black, green, and red. They are long-lived and probably as fire-resistant as slate or tile roofing. pt 32

Of these there are two general styles—American pattern and French pattern. The former are shaped and laid like a wood shingle or shingle tile, and the latter are square and laid diagonally. Shingles of French pattern are cheaper than the American per unit of roof coverage, because of the small loss in overlap. The loss for French is about 17%, and for American about 60%, but varies with the length of the shingle and number of inches exposed or "to the weather." pt 32

The rigid shingle should be laid on an asphalt-saturated roofing felt applied to a smooth sheathed roof surface. Copper clad or copper slate nails are recommended for fastening rigid shingles because the shingle will outlast nails that will rust. The cost of laying this type of roof, including labor and material, will be from 18c to 30c per sq ft. pt 32

SHEET METAL ROOFS

Sheet metal is applicable to both flat and pitched roofs. It is a very expensive form of construction as to installation, and, with some materials, also as to maintenance. Moreover, the high heat conductivity of the metal causes upper storeys of a house to become uncomfortably hot from direct rays of the sun. pt 32

Copper sheet. pt 32 **A3**

IX weight tinned copper bearing sheet is durable if painted with a suitable paint (red lead or waterproof asphalt-linseed oil paint) every two years. pt 32 **A3**

Tin sheet cannot be considered economical, despite its low first cost, because of high maintenance requirements. It must be repainted, preferably with red lead or with waterproof asphalt-linseed oil paint at least once every two years, and even with good care it may rust quickly. pt 32 **C3**

Zinc sheet expands and contracts greatly with changes in temperature, which may cause leakage. pt 32 **C3**

Lead sheet. Very expensive and little used. Copper-lead sheet very durable. pt 32 **B3**

SLATE SHINGLES

In durability slate compares favorably with good quality tile and copper. Variations in this respect are dependent upon hardness, and to some extent, thickness. Vermont slate is harder than that from Pennsylvania. Slate is graded according to color and thickness. The red and green slates (which come from Vermont) and the thicker slates are the more expensive. Guaranteed unfading slate should be used as some colors fade. Other than that, color has no significance but an esthetic one. pt 32

Always lay slate over wood sheathing covered with waterproof roofing felt. Use copper nails for slate shingles, two to each shingle. The price of laying a slate roof, including roofing felt, labor and material, runs from 25c to 65c per sq ft, difference in price reflecting differences of slate depending on color and thickness. pt 32

The following manufacturers of slate roofing material are recommended: F. C. Sheldon Slate Co. (Granville, N. Y.); Rising & Nelson Slate Co. (West Pawlet, Vt.); Vendor Slate Co. Inc. (Easton, Pa.); Structural Slate Co. (East Pen Argyl, Pa.) pt 32

TILE ROOFING

Tile roofing compares favorably with slate in durability and as a non-conductor of heat; maintenance is low. Initial cost, even in the cheaper grades, is, however, considerably higher than slate, varying in cost of installation, including labor and material, from 30c to $1 per sq ft. Difference in price on tile roof is due to the type of tile used. Generally shingle tile is cheapest to make and to lay. Formed tile, Spanish tile, interlocking tile, all require special roof preparation to provide fastenings. pt 32

Lay tile roofing similarly to slate over felt. pt 32

The following manufacturers of tile roofing are recommended: B. Mifflin Hood Brick Co. (Daisy, Tenn.); Ludowici-Celadon Co. (104 S. Michigan Blvd., Chicago). pt 32

WOOD SHINGLES

Wood shingles are not so durable as slate or tile. They are satisfactory with respect to heat conductivity, and are, with the exception of roll roofing and flexible shingles, the cheapest form of roofing. With respect to fire, however, they

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

present a serious hazard. Wooden shingles have been held responsible for much fire loss. The Department of Agriculture mentions sparks on combustible roofs as among the principal causes of farm fires. A bulletin called "Flying Destruction," issued by the National Fire Protection Association, says, "New wooden shingles may not look dangerous, but they furnish the tinder which starts and spreads conflagrations, especially when old and dry." u 31

The National Lumber Mfrs. Association, whose interest is of course that of ensuring as many uses of lumber as possible, has fought consistently against regulations limiting or prohibiting use of wooden shingles. In Minneapolis, passage of a proposed ordinance designed to abolish the use of wooden shingles as roof coverings was prevented by the lumbermen. (u 31) The lumber industry clearly admits its interest in securing continued permission for use of wooden shingles. In connection with the announcement of new red cedar shingle gradings, adopted in March 1931, the *American Lumberman*, "exponent of the American lumber industry," makes the following statement: "The principal reason for the change is because if we put them [the new standards] into effect the fire underwriters are willing to call off their dogs and to raise no objection to the use of quality shingles on homes in uncongested districts of a city. The new building code of the National Board of Fire Underwriters will no longer carry a clause prohibiting wood shingles within the city limits. . . ." (u 31) The most important provision in the new commercial standards for this commodity is that all commercial standard shingles shall be edge-grained. In other words, "It depended upon how a board was cut whether it would burn or not." u 31

The use of flammable roofing material—and wooden shingles of course fall into that class—puts a financial burden on the consumer of which he may not be fully aware. In the first place, there are additional insurance premiums and policies on a building with flammable roof, which, we are informed, average throughout the country between 10c and 15c per $100 of insurance. Moreover, where wooden shingles are permitted, the fire hazard is also figured in the base insurance rate of the community, so that not only the man with the wooden shingle roof but all policy holders of the district share in the added expense. Further expenses are the direct losses by fire, and higher maintenance costs for municipal fire protection. Wooden shingles of the flat-grain type and those not conforming to the new standards are, however, not to be permitted in the new code. u 31

Never lay wood shingles over a sheathed roof, as shingles need air circulation under them to keep them dry and so prevent rotting. Lay them on wood lath and nail each shingle to two bearing lath strips. pt 32

A roof formed of readily obtainable cedar shingles should cost about 13c per sq ft, including labor and material. If special hand cut, heavy butt shingles are used, or pre-stained creosoted ones, the cost may be 20c to 25c per sq ft. Where wood shingles are used, the pitch of the roof should be at least 30° and preferably 45° or greater. A roof with a 45° pitch formed with wood shingles will last 12 to 14 years without replacement. Creosoting and staining wood roof shingles will give longer life to the material but must be repeated every 5 years. pt 32

Cypress shingles have a tendency to curl and become leaky. pt 32

Red cedar shingles complying with commercial standard CS31-31 U. S. Bu. Stan. 1931. g 31

FLAT ROOFS

The most economical method of covering flat deck roofs, which will give a surface lasting 15 years or more with normal use, is the following: First lay heavy sheathing paper over the roof boarding and then tarred roofing felt; cover with pitch or asphalt; then lay two or three plies of tarred roofing felt with pitch or asphalt between plies; and finally coat with pitch or asphalt in which may be embedded gravel or slag, or finish merely with an extra heavy layer of tough waterproof roofing paper or asbestos paper. The slag or gravel surfacing is far more durable than any paper. Underwriters' Laboratories label should be required. pt 32

Asphalt, complying with or exceeding government specifications is preferable to pitch as it has more elasticity, will not crack in cold weather or run in hot. A finish surface of gravel or slag will have a tendency to be scraped in one direction and will cause trouble in clogging up the roof gutters and leaders which drain off the water. If the roof is to be used for recreational or other traffic purposes, it is advisable to cover the built-up roofing with promenade quarry tile (ordinary red tile, cheapest grade) laid in a bed of water-proofed cement mortar and with joints made of elastic material. Where flat roofs are behind parapet walls they should be flashed with built-up felt or sheet metal where roof surface meets wall. Roofs should always be slightly pitched toward drains to allow water to run off. See also *Sheet Metal Roofs* above. pt 32

HEAT INSULATING MATERIALS

In buying houses do not take anyone's word for the insulation. A house with ⅛ in. insulation may truthfully be represented as insulated, although of course the insulation will not be adequate. pt 32

Flexible Type insulation is sold in rolls and cut on the job to fit the space where it is to be installed and is generally secured in place by strips of wood lath holding its edges. If used for sound insulation it should never be placed under compression, as its efficiency for this purpose depends on loose packing. None of the flexible types listed has any fireproof or fire-resistant qualities. pt 32

Cabot's Quilt (Samuel Cabot, Inc., 141 Milk St., Boston) Made of eel grass held between two layers of *kraft* paper. Material price $20 per 1,000 sq ft in ½ in. thickness; $52 per 1,000 sq ft in 1 in. thickness. Labor cost for installation $65 per 1,000 sq ft. pts 32 **AA1**

Upson Blue Stripe (The Upson Co., 10 Upson Point, Lockport, N. Y.) Fluffy wood product held between two layers of *kraft* paper. Material price $60 per 1,000 sq ft in ¾ in. thickness. Labor cost for installation $65 per 1,000 sq ft. pts 32 **A1**

Balsam Wool. (Wood Conversion Co., Clocquet, Minn.) Much the same as *Upson Blue Stripe.* Material price $50 per 1,000 sq ft in ½ in. thickness; $80 per 1,000 sq ft in 1 in. thickness. Labor cost for installation $65 per 1,000 sq ft. pts 32 **A1**

Flax-li-num (Flax-li-num Co., St. Paul, Minn.) Fibrous material made from flax. Material price $50 per 1,000 sq ft in ½ in. thickness; $90 per 1,000 sq ft in 1 in. thickness. Labor cost for installation $70 per 1,000 sq ft. More difficult to apply than other makes. pts 32 **A2**

Loose Packed Type insulation is generally applied by the manufacturer or his licensed agents, as (except for *Sprayo-Flake*) it requires more than ordinary skill and often special equipment to apply it efficiently. pt 32

A *Recommended* | B *Intermediate* | C *Not Recommended*

Sprayo-Flake (Sprayo-Flake Co., 836 E. Bay St., Milwaukee, Wis.) The most economical, efficient, and easily applied material of any type. Made from shredded paper with silica and tar binder, applied by means of special pressure gun. Material and labor cost for installation complete $100 per 1,000 sq ft. Generally applied in 1 in. thickness which is sufficient. pts 32 **AA1**

Johns-Manville Home Insulation (Johns-Manville Corp., 294 Madison Ave., New York City) Very efficient material of fibrous rock, applied by pressure gun preferably, though it can be hand packed. Especially adapted to buildings already constructed. Material and labor cost for installation complete $250 per 1,000 sq ft. Material is fireproof and is generally applied in 4 in. thickness. pts 32 **A3**

Mineral Wool (U. S. Mineral Wool Co., 280 Madison Ave., New York City) Fibrous material made from slag. Generally applied in 4 in. thickness. Difficult to apply efficiently due to hand packing. pts 32 **B2**

Rigid Board Type insulation comes in sheets of varying thickness though the standard thickness is $\frac{7}{16}$ in. It may be used either inside or outside wall studding and underneath rafters. Some building codes prohibit its use on outside of studding when used in place of wood sheathing. Never plaster directly on its surface without minutely and carefully following directions of the manufacturer or cracking of plaster may result. It is sometimes desirable to apply metal lath, screening or other mesh to the joints of the boards, or to fill joints with special compounds recommended by the manufacturer. A patent plaster, *Solidon* (The Solidon Products Co., Wolf and Water Streets, Philadelphia) has been found the best available plastering material on this type board, but the *Solidon* representative should be present during application of insulation and at the start of plastering. None of the boards below is fire-proof or fire-resistant. All wood-pulp boards tend to discolor and become "crumbly" from oxidation and the action of mould spores. pt 32

Treecraft (Treecraft Corp., 347 Madison Ave., New York City) An imported Swedish product made from wood pulp. Less expensive than others of this type. pts 32 **AA1**

Temlok (Armstrong Cork & Insulating Co., 935 Concord St., Lancaster, Pa.) A domestic wood pulp product considered a good material. pts 32 **A1**

J-M Insulating Lumber (Johns-Manville Corp.) A domestic wood pulp product widely distributed and considered good. pts 32 **A1**

Insulite (Insulite Co., Builders' Exchange, Minneapolis, Minn.) A domestic wood pulp product widely distributed and considered good. pts 32 **A1**

Masonite (Masonite Corp., 111 W. Washington St., Chicago) A good insulating material but high in price compared with others equally efficacious. pts 32 **A2**

Maftex (National Gypsum Co., 409 Jackson Bldg., Buffalo, N. Y.) A product made from licorice roots. By one adviser considered the best insulating material of the rigid board type. Made in thicknesses of $\frac{7}{16}$ in. and 1 in. pt 32 **A3**

Armstrong's Corkboard (Armstrong Cork & Insulating Co.) An excellent insulating material; generally 1 in. thick; made of cork; expensive and more costly to apply than other makes of fibrous material. Tensile strength low. pts 32 **A3**

Gold-Bond Insulation Board (National Gypsum Co.) A good insulating material but most expensive of this type. pts 32 **A3**

Celotex (Celotex Co., 919 N. Michigan Ave., Chicago) Made from sugar cane fibre. pts 32 **C1**

There is very close competition between all manufacturers of rigid board type insulation and before ordering any one brand the consumer would do well to advise several manufacturers or dealers that he was considering the use of their products and that the contract would be awarded largely on the basis of price. The average material price on rigid board insulation is $45 per 1,000 sq ft; labor cost for installation is $20 per 1,000 sq ft. pt 32

SCREENS

Wire Mesh. The wire mesh commonly used in window and door screens is No. 16 (16 strands to the inch) which excludes both flies and mosquitoes. If gnats are prevalent, No. 18 wire mesh should be used. The edges of all wire mesh should have a selvage. pt 32

Bronze wire mesh is long lived, stronger than copper, and now relatively cheap. The only objection to bronze wire mesh is that it may stain the surrounding woodwork. pt 32

Monel metal wire mesh is more expensive than bronze, but overcomes the staining difficulty. pt 32

Aluminum wire mesh is satisfactory, except near salt water. pt 32

Mesh of iron wire and galvanized iron wire are not recommended because of the rapidity with which they rust. pt 32

Pure copper wire mesh is too soft, and like bronze mesh, likely to stain the woodwork. pt 32

Wire mesh of other metals and alloys are on the market and claims of durability and long life are made for them, but service tests on these newer products are not conclusive. pt 32

The prices (approximate) per square foot of the various kinds of wire mesh are as follows:

Bronze	7c
Copper	6c
Aluminum	7c
Galvanized iron	5c

pt 32

Frames. Frames for holding wire mesh should be of such construction as to allow replacement of the mesh without injury to the frames. In both wood and metal frames this is accomplished by the use of a groove and spline, or strip, to hold the mesh in place. Wooden frames should be joined by concealed mortise and tenon construction, well glued and wedged. Wooden frames for window screens should be at least $\frac{13}{16}$ in. thick, and doors at least $1\frac{3}{8}$ in. thick. Wooden frames are much less expensive, and if made of well seasoned material, and kept properly painted, are as satisfactory as metal frames. Repairing metal frames is very expensive and for most persons, impossible. Iron frames should not be used, because of their tendency to corrode. pt 32

The various openings of a house require their own particular methods of screening. Some of these are considered in the following paragraphs.

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

Door. Screen door frames should be divided into panels for strength. Iron frames should not be used; other (non-ferrous) metals for screen door frames, while satisfactory, cost twice as much as wooden frames. pt 32

Double-hung window sash. This type generally has the screen on the exterior face of the window frame, using either full- or half-length screens. Full-length screens are easier to install and remove, have a neater appearance, and cost very little more than half-length screens, which are of grooved frame construction, and are always apt to stick in most annoying and unmanageable fashion. pt 32

Inward opening casement sash. This type is generally screened with full-length exterior screens. pt 32

Outward-opening casement sash. Such openings must be screened on the inside of the sash, using one of the following methods: (1) Fixed screen, through which is run a casement sash opening-and-closing device; because of this device, more expensive than any of the other types. Further, the device is likely to be out of adjustment much of the time. (2) Horizontally sliding screens of two or more sections. Satisfactory provided no warpage occurs in the dividing strips; consequently, non-rusting metal is preferred to wood for the frames of this type. (3) Side-pivoted or top-hinged screens. Cheapest type, but interfere with draperies in opening and closing. (4) Rolling screen. Recent mechanical improvements, and a reduction in price, make the roller screens much more satisfactory for inside screens than in the past. The mechanical spring rollers are more complicated than other types but they have the important advantage that they do not have to be removed and stored, but roll up in a metal box head at the top of the window frame. They require adjustment at least once a year, and the consumer should obtain a five-year guarantee of free service and repair before ordering them. pt 32

Relative prices. The following table shows the present cost of screening a window opening 5 ft high by 3 ft wide, using No. 16 mesh bronze wire in all cases. As only one opening is considered, the costs are high. In actual construction, where several openings are screened at once, the unit price will be much lower. These prices are only approximate, since screening the openings in a building requires many allowances both for individual desires and building design.

Full length exterior wood frame screen	$5
Full length exterior bronze frame screen	10
Half length exterior wood frame screen	3.50
Half length exterior bronze frame screen	6
Pair of side-pivoted interior wood frame screens	11
Pair of side-pivoted interior bronze frame screens	18
Pair of horizontal sliding interior wood frame screens	10
Pair of horizontal sliding interior bronze frame screens	17
Interior rolling screen	9.50

Wood frame screens will be furnished by local carpenters or lumber mills, but for metal frame screens or rolling screens the consumer may obtain estimates from any of the following manufacturers or their sales representatives:
E. T. Burrowes Co., Inc., 70 Free St., Portland, Me.
Chamberlain Metal Weatherstrip Co., Detroit, Mich.
Higgin Mfg. Co., Newport, Ky.
Jamestown Screen & Mfg. Co., Jamestown, N. Y.
Kane Mfg. Co., Kane, Penna.
Rollscreen Co., Pella, Iowa.
Watson Mfg. Co., Jamestown, N. Y. pt 32

All purchases should be made on the basis of competitive bids.

INTERIOR WALL FINISHES

There are so many ways of finishing interior walls and partitions and such a variety of materials from which to choose, that CR can only classify methods and materials in a general way. It suggests that the consumer write for additional information and advice on any particular problem not covered herein to the Bu. Stan. or the Bu. Home Ec., Washington, D. C. The Architects' Small House Service might also be consulted (see *Reference,* col 52). pt 32

PLASTER

The almost universal method of finishing interior wall and ceiling surface is by plastering, either directly on masonry surfaces composed of hollow tile, gypsum blocks, cinder blocks, brick, or concrete; or on lath secured to stud and wood joists and to wood and metal furring. (pt 32) Plaster has the advantage of good fire resisting, heat insulating and acoustic properties. Its natural color provides a simple index to quality. The best plasters are bluish; pure white denotes a good quality; the poorest grades have a buff or reddish tinge. (g 20) There are many substitutes for lath and for lath and plaster, for all of which economy and better results are claimed. Plastering is messy work, and slow work when the time required for it to dry out is added to the time required for application. Moreover, plastering cannot be done during freezing temperatures unless temporary heat is provided to prevent damage. With all the disadvantages of plastering as the urge behind the quest for satisfactory substitutes, it can be stated without fear of contradiction that none has been found. pt 32

Preparation for Plaster. Masonry surfaces to be plastered should be treated to prevent staining of the plaster and to provide a bond between the surface and the plaster coat. Rough surfaces of hollow tile and brick should be completely coated with emulsified asphalt or an asphalt-linseed oil paint (*Valdura,* American Asphalt Paint Co., 393 Seventh Ave., New York City). Smooth surfaces affording no bond should be coated with asphalt with which, while still fresh, coarse sand is blown. Gypsum block requires no such treatment. Concrete surfaces should be thoroughly chipped with a concrete pointing hammer or the inside surfaces of the forms in which the concrete is poured should be coated with *Contex* (Concrete Surface Corp., 60 E. 42 St., New York City), which prevents the set of the cement in the face of the concrete to a depth of about ¼ in., exposing the clean aggregate. After the forms are stripped, the loose material on the face of the concrete must be removed by brushing and washing. pt 32

Lath. All lath used should be an expanded metal lath of any one of the many types available. Preferably it should be galvanized. It should be not lighter than No. 24 gauge. Metal lath should be fastened to wood stud, joists and furring with galvanized staples, and to metal furring with galvanized tying wire. pt 32

Plaster applied to wood lath will not stand as well as on metal lath, because wood lath moves with seasonal changes in humidity and often breaks the plaster key. Wood lath "shadows" plaster ceilings. pt 32

Plaster should never be applied directly on the interior surfaces of exterior masonry walls. Such walls almost always absorb and transmit moisture which will injure the plaster. If exterior walls do not leak, they will "sweat." All exterior walls to be plastered should be furred on the inside either with hollow furring tile or wood furring. pt 32

Plaster Boards. The market offers a number of substitutes for lath in the form of sheets or boards to be nailed to stud and joists. Sometimes the rigid insulating boards are urged for this purpose. Their use, it is claimed, makes possible the omission of one or two coats of plaster, but actually does not result in a first class job of plastering. pt 32

Plaster should be applied to plaster board only in strict ac-

A *Recommended* B *Intermediate* C *Not Recommended*

cordance with recommendations of the manufacturer of the wall board, or those of a competent architect. Otherwise cracks in the plaster may be expected to develop at the joints in the plaster board. *Solidon* (Solidon Products Co., Wolf and Water Sts., Philadelphia) a special plaster, is recommended for use on wall board. pt 32

Application of Plaster. Good plaster finish can be produced only with three coats—scratch coat, brown coat and finish coat. Where a rough surface is desired, the finish coat may be omitted and the finish produced by "floating" (applying with wooden trowel by circular motion) the brown coat. Gypsum plaster is generally used for the scratch and brown coats. The neat material should be mixed with clean sand in the proportions recommended by the manufacturer of the plaster. pt 32

Plaster requires from two to four weeks, according to weather conditions and temperatures, to dry sufficiently to receive any kind of painted finish. pt 32

Colored wall plaster. Wall plasters colored with mineral pigments are not satisfactory. Colored plasters in which coloring has been applied to the aggregate or filler are reported satisfactory. Redecoration can be accomplished by painting or plastering over the original coat, by covering with wall paper, etc. g 20

See *Colored Wall Plaster—Tech. Paper* 181, by Warren E. Emley and Charlotte F. Faxon. 5c from Supt. of Docs. 8 pp. Washington: U. S. Bu. Stan. Dec. 1920.

WALL-PAPER

The least expensive finish is wall-paper. A good grade of wall-paper may be purchased for 65c per roll, and for the average room 10 rolls are sufficient. A good paper-hanger can apply the material to one room in a day's time. Don't apply paper over wall board, for no matter what treatment is given the joints of the wall board, there will be movement there with consequent tearing of the paper. Any contrary recommendation from wall board or wall-paper manufacturers may, in our opinion, be wisely disregarded. pt 32

Before papering over plaster, see that the plaster is thoroughly dry; give it a good coat of shellac or glue size to prevent the lime in the plaster from "burning" through the paper and causing discoloration. Papering ceilings is apt to be unsatisfactory, as the paper is likely to peel off, due to increase in weight following the absorption of moisture. pt 32

Wall-paper is easily replaced at a small expense. Remove the old paper by wetting thoroughly with water and scraping off with a scalpel. pt 32

There are many waterproof-coated papers on the market for papering, such as *Salubra* (Frederic Blank & Co., New York Central Bldg., New York City) or *Sanitas* (Standard Textile Products Co., 320 Broadway, New York City) which are easily cleaned with soft soap and water. They are more expensive in first cost than plain wall-paper and are also more difficult to hang, requiring more time and care on the part of the paper-hanger. Plain wall-paper can easily and quickly be given a coat of transparent water-proof varnish which will greatly increase its durability. pt 32

Never use wall-paper around a shower bath or bath tub as contact with water and highly humid air will fade the pattern and cause the paper to peel off. It is advisable when using a paper that costs more than $2 per roll first to line the wall with a thin cloth lining. This will prevent cracks in the wall from showing through or tearing the paper. pt 32

Thin veneers of wood backed with cloth are to be avoided. They are difficult to apply and come off the backing easily. *Flexwood* (The Flexwood Co., 4413 Division St., Chicago) is a product of this nature. Real wood panelling of simple design is no more expensive than this type of construction and compares favorably in price with a papered plaster wall. pt 32

PAINTING

The successful and durable painting of plaster is a most difficult problem, and the Bu. Stan. letter circular 304 on the subject should certainly be consulted. In reading this, one needs to make allowance for the circumstance that the circular (which supersedes a previous edition that caused controversy embarrassing to the Bureau) greatly understates some of its judgments, particularly those points which might be read as unfavorable to the use of lead zinc and oil paint on plaster walls. The present document, though far less objectionable to the oil paint trade than its predecessor, is very useful, even to consumers, if read with the above point in mind. pt 32

Failures of paint on plaster occur frequently and in some cases are hard to account for, except by technical examination quite unavailable to the ordinary consumer. Such failures are commonly and often erroneously ascribed to the presence of excess moisture in the plaster, but they occur in many cases where abnormal moisture cannot account for the difficulty. The damage to a paint surface on a plaster wall comes from the alkalinity of the normal traces of moisture which may permeate the wall in certain climates and under conditions which may recur from time to time. It is most essential that plaster should be thoroughly dry before applying any oil paint, and, even with the best intentions, one may in practice often apply oil paint to plaster that is not nearly dry enough. A recommended method is to slightly roughen the thoroughly dry plaster surface by sandpapering, dust thoroughly, and apply a size coat of water-resisting varnish thinned with turpentine or mineral spirits. On this, when thoroughly dry, apply a first coat of paint containing considerable boiled oil, and use the fewest possible number of additional coats to give the desired appearance (information from Bu. Stan. circular). g 31

A strong solution of aluminum sulphate or zinc sulphate is often applied to a new plaster wall before painting. The common practice of using glue size is thought by some to be unwise. A plaster wall allowed to stand a year before painting gives one much better chance of satisfactory results from painting (if oil paint is to be used). u 27, 29

Cold water paints with a casein binder can be applied to damp walls, and are probably the safest kind of paint to apply to plaster that is hardened but not assuredly completely dry. In considering cold water paints, their low first cost is important. They have the disadvantage of not being washable, and of rubbing off on clothing when touched. In any case, however, they are to be highly recommended for use on ceilings. cr 32

Old plaster surfaces must be cleaned (before painting) with washing soda and water to which a little ammonia has been added. If surfaces have been previously whitewashed or calcimined, it is absolutely necessary to wash all such coating off before preparing the surface for painting. u 27

A flat (matt) paint finish, while restful to the eye, cannot be washed without streaking and shows marks very easily. If an oil paint is used, an enamel gloss finish is best for hard use and cleanliness and is particularly advised for walls in bathrooms and kitchens. The plaster base of walls of the latter should be a special dense plaster such as *Solidon* (The Solidon Products Co., Wolf and Water Sts., Philadelphia) or *Keene Cement* (The Best Bros. Keene Cement Co., Medicine Lodge, Kansas). In such locations ordinary plaster absorbs moisture easily and then disintegrates. pt 32

See page 2 and the *Introduction to Consumers' Research* for explanation of the listings

PLASTIC FINISHES

There are available a number of materials known as plastics. They are in fact plastic paints, both oil and water, and are used to produce decorative finishes known as "textured," by various methods of application. In cheap work they are sometimes applied directly to plaster board and insulating boards over a coat of sizing. This short cut to results is not recommended. pt 32

TILE

For bathroom walls, tile applied over cement mortar and metal lath base is the most durable and satisfactory material. Plain white tile in stock sizes is not expensive and is easily cleaned: Glazed tile is graded on a No. 1, 2, 3 basis. Grades vary considerably from one product to another; grade 1 should always be selected, as the price differences are negligible on small lots. There are many tile substitutes on the market, such as *Vitrolite* (The Vitrolite Co., Parkersburg, W. Va.), a glass product which is very expensive (more costly than marble) and subject to cracking. Asbestos tiles and zinc coated asbestos tiles, which are surface treated with lacquer or paint, are too expensive in initial cost to prove of ultimate economy; they crack more easily than glazed tile. pt 32

LINOLEUM

Linoleum (special light weight material—Congoleum-Nairn Co., Kearny, N. J.) is rapidly gaining popularity as a wall covering for bathrooms and kitchens. It provides a durable, easily cleaned and decorative wall covering. It is successfully used as wainscoting in place of tile and is priced at less than one-third the cost of tile. pt 32

COST GUIDE

The following guide is submitted to show *relative* costs of different bases for wall finish and of wall finishes themselves. In all cases it includes labor and material for installation and is based on average prices at 1932 levels:

Bases	*Price per sq yd*
Wood lath	20c
Metal lath	23c
Wall board	40c-60c
2 coats plaster	50c
Terra cotta block (4 in. thickness)	$2

Finishes	*Price per sq yd*
Wall-paper	40c-60c
3 coats of paint	60c–80c
Metal or asbestos tile	$4-$6
Glazed tile	$5-$7
Marble	$6-$8

pt 32

FLOORS AND FLOORING

The use or abuse to which a floor will be subjected should dictate the general class of flooring material from which the final selection is made. Will the floor be impervious to moisture? Will it be disfigured by hot grease? Will it stand up under shuffling traffic? Will it give a smooth semi-slippery surface suitable for dancing? Will it have the warmth and resilience desirable in a bedroom floor? These are typical of the first questions which the prospective purchaser should ask. There are also considerations of appearance, ease of cleaning, comparative durability and, of course, the cost. In the following discussion an attempt is made to classify flooring materials on the basis of their physical properties and therefore their suitability for use in the various parts of the home or building. This classification is followed by a description of each of the materials mentioned and the methods of laying them. pt 32

Moisture resisting floors. The following materials, if properly laid, will produce floors that are highly resistant to and will not be injured or defaced by moisture: glazed and vitreous tile, terrazzo, cork tile, rubber tile, linoleum which has been finished with waterproof varnish or lacquer, teak laid with white lead or oiled joints, mastic or asphalt tile and magnesite. Because of their resistance to the penetration of moisture, these floors are sanitary and easy to clean. pt 32

Grease resisting floors. Floors of the following materials will not absorb or be disfigured by grease or slop, as in a kitchen: glazed or vitreous tile, quarry tile, terrazzo, rubber tile, linoleum finished with a waterproof varnish, and magnesite. pt 32

Weather resisting floors. Floors which will withstand exposure to weather, as for open porches and terraces, may be made of the following materials: concrete, glazed or vitreous tile, terrazzo, quarry tile, promenade tile, white pine, rift- or edge-grain fir, teak. pt 32

Abrasion resisting floors. Floors which will give satisfactory service under heavy pedestrian traffic are: concrete especially surfaced, terrazzo, vitreous and "non-slip" tile; and to a lesser degree, some of the hardwood floors such as quarter-sawed oak, maple, birch and rift-sawed or edge grain yellow pine. The life of this latter class of semi-resistant floors depends largely on the care and upkeep they receive. pt 32

Warm, resilient floors. Floors of comparative warmth, resilience and quiet, comfortable to live with, include the following: quarter-sawed or flat-sawed white or red oak, yellow pine, maple, rift-grain fir, Southern pine, cork tile, linoleum and all of the more expensive hard woods such as mahogany, ebony, walnut, teak. pt 32

WOOD FLOORING

Grades. Rules of specifications for the various qualities or grades for each of the kinds of wood used for flooring have been adopted by the various associations of producers and are used as standard descriptions by both purchasers and suppliers. Only by asking two or more suppliers for quotations on the same grade can comparative prices be secured. These standard specifications or grading rules may be secured on loan, without charge, from the American Standards Association, 29 W. 39 St., New York City. If the purchaser is unfamiliar with what these grading rules mean in terms of allowable defects, samples should be examined before the decision is made and prices asked for. pt 32

All wood flooring should be thoroughly kiln dried and carefully protected from moisture until finished. Flooring which is not dry when laid will shrink and twist after laying, producing unsightly open joints and an uneven surface. pt 32

Finished wood floors should be laid over a rough floor with a thickness of building paper or felt between. pt 32

Wood floors, generally in pattern, composed of short lengths, may be laid over a smooth concrete surface, by sticking with an especially prepared mastic. The wood in such floors must be milled to provide a key groove for the mastic. pt 32

Oak. Two species of oak are commonly used for flooring, namely, white oak and red oak. Red oak is not quite so tough or durable as white oak, and costs less. The difference in durability between red oak and white oak may be disregarded in the selection of floors for residences. Many persons prefer the richer color of red oak. Oak flooring is produced in quarter-sawed and plain-sawed. The grain in the quarter-sawed material is approximately vertical to the floor surface. It will not splinter, shrinks less, is harder and more durable, but costs more than plain-sawed flooring. All

standard oak flooring is $\frac{25}{32}$ in. thick, tongued and grooved on the sides and ends, $2\frac{1}{4}$ in. face, and in lengths provided by the rule for each grade; the poorer the grade the larger the percentage of short lengths.

Laying: Should be tightly driven up and nailed with 8d cut floor nails spaced not more than 10 in. apart. The surface should be planed where necessary and scraped, or machine sanded, sanding by hand around base boards and in corners; then covered with heavy building paper until all painting and other work in room is finished.

Finishing: Apply a paste filler with stain mixed into it if a darker color than that of the natural wood is desired. Oil or wax over filler. If oil is used, a mixture of 1 gal raw linseed oil, 1 qt turpentine and $\frac{1}{2}$ pt drier is recommended. Two coats of oil or wax are recommended for first finishing, the second coat applied 48 hrs after the first. Instead of oil or wax, in rooms where there is little traffic, two coats of floor varnish or quick drying spar varnish applied over the filler will produce a very satisfactory finish, less slippery and requiring less care than wax or oil finish. Wax may be applied over the varnish. Opinions regarding use of shellac vary. One exceptionally well-informed consultant advises that it should not be used in finishing floors. pt 32

Maple. Maple is an extremely hard, close-grained wood and is recommended for floors which will have to withstand heavy traffic as in stores, armories, gymnasiums, school rooms and public dance halls.

Laying: Should be laid same as oak flooring.

Finishing: No filler is required for maple. The oil or wax should be applied direct to the clean wood. Greater penetration and durability of finish will be secured if the first coat of oil or wax is applied hot. pt 32

Yellow Pine. Yellow pine flooring is procurable in either plain-sawed (flat grain) or rift (edge grain). Heart rift is cut entirely from the hard inside portions of the tree and contains no soft or sap wood. Heart rift is a most durable material and costs more than oak. Yellow pine should not be used where it will be exposed to the weather unless it is treated to prevent dry rot.

Laying: Same as oak.

Finishing: Same as oak. pt 32

Southern Pine. This material is inferior to oak, maple and yellow pine. It is probably the most generally used flooring in low cost work. It is procurable in both flat-sawed and rift-sawed. As with oak and yellow pine, the rift-sawed (edge grain) material is superior to flat-sawed.

Laying: Same as oak, except that the class of material and its cost do not warrant the same care in laying and surfacing.

Finishing: Same as oak or yellow pine. pt 32

Fir. Douglas fir from the Pacific coast is coming more and more generally into use. It is an open grained, splintery wood. Only the better grades of rift-sawed material should be used for flooring. It resists rot and therefore is suitable for use where exposed to the weather.

Laying: When laid exposed to the weather, galvanized 8d cut floor nails should be used, and the edges, before laying, should be coated heavily with white lead. Otherwise, fir flooring is laid and surfaced the same as oak.

Finishing: When exposed to the weather, finish with two coats of deck paint. Interior fir flooring is finished the same as oak or yellow pine. pt 32

White Pine. White pine is highly resistant to the attacks of of the elements, which qualifies it for exterior use; but it has the disadvantage of being extremely soft and therefore is easily disfigured. It is used extensively for decks of yachts.

Teak: Teak, because of its toughness and resistance to moisture and grease is a highly desirable wood for flooring. Its cost is about three times that of quarter-sawed white oak. It is not procurable in any standard dimensions or milling. For floors it is generally used only for the face of three ply built up boards, milled with tongues and grooves. It is of a rich brown color, beautifully grained and makes an extremely handsome floor.

Laying: When laid where there will be moisture, the joints should be white leaded or oiled.

Finishing: Oiled or filled and waxed as for oak. pt 32

RUBBER TILE

The resilience, impermeability and noiselessness of rubber tile make the material peculiarly suitable for floors in kitchens, bath rooms, or hospital corridors. Tile made from new rubber or new rubber compounded with a limited percentage of reclaimed rubber, relatively hard and of darker colors will produce the most satisfactory floors. The production of light colors requires large additions of inert fillers and coloring matter and a corresponding decrease in the rubber content. Such tile tend to lose their resilience with aging. So-called cushion-backed tile or tile made with a face of different composition from the backing are inferior and should be avoided. pt 32

Laying: For the best results, rubber tile should be laid over a hard firm base such as concrete, but can be laid over other surfaces. The material is difficult to lay and requires the employment of skilled mechanics. Rubber tile floor should not be purchased without a guarantee requiring the contractor to replace defective material. pt 32

Among the manufacturers of and contractors for rubber tiling who have acquired a reputation for producing satisfactory work are the following: American Rubber Products Corp. (125 E. 46 St., New York City); American Tile & Rubber Co. (Perrine Ave., Trenton, N. J.); Hood Rubber Co. (Watertown, Mass.); Stedman Rubber Flooring Co. (S. Braintree, Mass.); U. S. Rubber Co. (355 Valley St., Providence, R. I.); Syra-Bord Rubber Flooring Co. (Syracuse, N. Y.); Wright Rubber Products Co. (Racine, Wis.) pt 32

LINOLEUM

Linoleum is generally marketed in 6 ft widths, which vary in thickness or gauge. For household use, the *light battleship* or A gauge (approximately $\frac{5}{32}$ in. thick, weighing slightly less than 1 lb per sq ft) and B gauge (approximately $\frac{1}{8}$ in. thick, weighing about $\frac{3}{4}$ lb per sq ft) are satisfactory. pt 32

Several types of linoleum are obtainable: plain—a patternless linoleum, which very readily shows footmarks and is hard to keep clean; inlaid linoleum, which is patterned in such a manner that the design appears through to the burlap backing (observe this at an exposed end); jaspé linoleum, an inlaid type without a definite pattern—its effect somewhat like that of wood graining—probably the most desirable, as most easily kept clean. Always look for the trade name *linoleum*, and the grade, stamped on the burlap back, to distinguish from imitation with poorer wearing quality. pt 32

Armstrong's Linoleum (Armstrong Cork Co., Lancaster, Pa.) pt 32

Sealex Linoleum (Congoleum-Nairn Co., Kearny, N. J.) pt 32

Blabon (Sloane - Blabon Corp., Philadelphia) pt 32

Printed linoleum, since decorated by painting the surface of plain linoleum, does not hold its decoration long.

Linoleum-like products on which the name *Linoleum* does not appear unequivocally. cr 32

Congoleum should not be confused with linoleum. It is a surface-treated product and not durable, although much cheaper than linoleum. (pt 32) If such impermanent flooring is desired, there is believed to be no difference in wearing qualities between the *Gold Seal* and *Silver Seal* Congoleum. pt 30

A *Recommended* B *Intermediate* C *Not Recommended*

Laying: Flat grained pine is particularly suitable for foundation flooring. It should be absolutely smooth and level. Cement the linoleum to a 1½ lb felt lining and in turn cement this to underfloor, taking care that a continuous film of waterproof cement is applied. The sheets of linoleum should be lapped about ¾ in. at edges as they are laid and a tight flush joint formed by cutting through both thicknesses with a sharp linoleum knife. Room temperature during laying should be about 70° F. pt 32

TERRAZZO

Terrazzo is composed of Portland cement, mortar and small chips of colored marble. The marble chips are sprinkled thickly over the mortar bed and tamped or rolled in. When a non-slip floor is desired, granules of an abrasive such as carborundum or alundum are mixed with the marble chips or used alone. After setting hard, the surface is ground to either a honed or polished surface. The honed surface is preferable. The color or colors of the floor are produced by the marble chips used, either alone or sometimes in combination with colored mortar. pt 32

Terrazzo should be laid in units not exceeding 4 ft in any dimension, the units separated by brass strips, to insure against the development of unsightly cracks. pt 32

Terrazzo should be bought on carefully prepared specification and approved samples. pt 32

VITREOUS TILE

Vitreous tile are used in form of encaustic tile mosaic (small units, square, hexagonal, or oblong) in plain colors or pattern, and laid in sheets of tile pasted on paper, or in the form of individual units known as "flints." Encaustic tile mosaic floors are much less expensive than flint tile floors. Both are hard and cold, but non-absorptive and easily cleaned. pt 32

GLAZED TILE

Glazed tile for floors are produced in a great variety of shapes, designs and colors. They should be considered only for special use as a part of a general decorative scheme. The body of such tile is of hard burned clay and the glaze is heavy and generally referred to as faience. pt 32

QUARRY TILE

Quarry tile are square (6 x 6 in. generally) hard burned, impervious to moisture, fairly smooth surface, ¾ in. thick for heavy duty. They come in a range of reds and browns. They are laid individually with joints $\frac{3}{16}$ in. to ¼ in. wide as a minimum. This joint width is necessary because the tile are not absolutely uniform in dimensions. pt 32

PROMENADE TILE

Promenade tile are similar to quarry tile except that they are 6 x 9 in. and are not so well manufactured. They are chiefly used for covering flat roofs on which there is traffic and for less expensive terrace flooring. They are produced in a range of red colors. If no color selection is required, the price is lower than when limits are set for the range. pt 32

CORK TILE

Cork tile are made of ground clear cork shavings compressed in a mold and baked. The natural gum in the cork cements the particles together. The tile are made in two thicknesses—$\frac{3}{16}$ and ½ in.—and almost any size up to 12 x 24 in. The material is sometimes laid in strips, herringbone pattern. The $\frac{3}{16}$ in. thick tile are cheaper than the ½ in. and where the traffic is not heavy, as in a private office or residence, will give equally satisfactory service. pt 32

A *Recommended* B *Intermediate* C *Not Recommended*

Cork tile are sanded smooth after laying, and, except in bathin a waterproof cement with tight joints. It may be satisfactorily laid over a smooth wood floor by first covering the floor with tightly stretched muslin thoroughly tacked over a thickness of building paper. The cork tile are cemented to the muslin. pt 32

Cork tile are sanded smooth after laying, and, except in bathrooms, should be finished by applying a coat of paste filler and two coats of linoleum lacquer or quick drying floor or spar varnish. pt 32

Cork tile of good quality are manufactured and laid by Armstrong Cork Co. (Lancaster, Pa.) and David E. Kennedy, Inc. (16 E. 52 St., New York City). pt 32

MASTIC TILE

Mastic tile are made from asphalt to which are added fillers, pigments and other ingredients intended to give them color, pliability and other properties. Such tile should not be used unless the floor will have to withstand acids. The tile is hard, and when cold is brittle. When warm it is soft and is disfigured by furniture. Generally, it is laid over a smooth concrete floor in asphalt emulsion. pt 32

MAGNESITE

Magnesite is a composition consisting principally of magnesium chloride (liquid) and powdered magnesium oxide. Various fillers such as ground cork, asbestos, marble chips, etc., are added, together with coloring matter. A chemical reaction between the chloride and oxide, after mixing, produces a hard cement. But the hardness and durability of this resultant cement depends upon the proper proportioning of the chloride and oxide. If there be an excess of either the floor will be defective. The chloride (liquid) is sometimes absorbed in part by a porous concrete under-floor, and, if this suction is not measured and allowed for, the result will be unsatisfactory. No such precautions need be taken when the material is applied to a wood floor. pt 32

Proprietary brands of magnesite flooring are more expensive than the component materials, which can be purchased from supply houses. The quantities required to cover a given area and directions for use can be secured from the suppliers of the material. pt 32

CONCRETE

Concrete floors, if the ingredients are properly proportioned and properly laid, are extremely serviceable and have a wide variety of appropriate uses. There is no better or more economical flooring for garages, cellars, lofts, terraces. Mineral coloring may be added to finish where appearance is important. Painted finishes for concrete are not recommended. Treatments to render concrete floors dustless or to harden the surface are not always effective and are unnecessary if the concrete mix is right and properly worked. (pt 32) See U. S. Bu. Stan. Letter Circular 139—*Report of Service Tests on Concrete Floor Treatments.* Free upon request to the Bureau.

Laying: Concrete floors may be installed in one or two operations (monolithic or in a base floor and finish coat). Where the finished floor is not subject to traffic and damage before it has set hard, the monolithic floor is recommended. In either case the surface to be covered should be clean and approximately true. If the surface is of earth it should be covered with a layer of broken stone gravel or cinders tamped in place. Place over the surface thus prepared a layer of concrete about 3 in. thick, composed of 1 part of Portland cement, 3 parts of coarse clean sand and 5 parts of ¾ in. broken stone or gravel, and only enough water to permit the material to be spread and leveled. "Soupy" mixtures and

A *Recommended* B *Intermediate* C *Not Recommended*

mixtures which become "soupy" when tamped will not give the best results, because in such mixtures the stone or gravel tends to separate from the cement and sand and the final concrete will be porous. This base should be tamped and roughly leveled with a long straight-edge. If a finish coat is to be applied later the surface should be roughened with a rake and covered with single ply roll-roofing or tough heavy waterproof paper. If a monolithic floor is to be laid, the finish coat is applied immediately. pt 32

In both types of floor, the finish coat is composed of 1 part of Portland cement and 2½ parts of coarse sand, and only enough water to produce a mortar that can be spread. Keeping the water content in the finish coat down to the minimum is important to insure against a separation of sand and cement under the trowel. The fine material which floats to the surface of a soft mix when troweled later dusts off the floor and often causes cracks and incipient disintegration. The object should be to so mix and work the materials that the wearing surface will be composed largely of sand. pt 32

If the finish coat is applied to the rough base floor after the latter has set hard, the surface of the base should be thoroughly cleaned and soaked for 24 hours. Sometimes a bond between the base and the finish cannot be secured without chipping the base or cleaning it with an acid solution. If acid is used, the surface must be thoroughly washed to remove all traces of acid before the finish is applied. The finish coat should be kept moist for five to seven days after laying to insure against quick curing, shrinkage and cracks. It is advisable to embed in the center of rough base floor some kind of metal mesh, heavy chicken wire or expanded metal, as a reinforcement. pt 32

COMPARATIVE COSTS OF FLOORS

These costs are for a square foot of flooring, *laid*, and are based on recent price quotations from reliable flooring contractors. They do not take account of cost of care and maintenance over a period of years, which varies with the different materials; e. g., it has been estimated that the cost of materials, laying, care, and maintenance for linoleum (on which initial investment is low) is as high as that for tile; while the corresponding cost for terrazzo is higher than that for tile. u 31

Material[1]	*Price per sq ft, laid*
White oak. Quarter-sawed; clear grade, 25c; sap clear, 23c; select, 21c; plain-sawed, select, 19c; clear, 18c; No .1 common or third, 16c	16c–25c
Maple. Plain-sawed; clear, 19c; No. 1, 18c; factory grade strips, 16c	16c–19c
Yellow Pine. Rift-sawed; grade A heart, 27c; grade B heart, 25c; grade A sap, 21c; Flat-sawed; grade A sap, 20c; grade B sap, 17c; grade C, 15c	15c–27c
Teakwood. Laid straight, 65c; herringbone pattern, 85c	65c–85c
Walnut, Mahogany, Satinwood. Herringbone pattern, 70c	70c
Macassar Ebony. Herringbone pattern, $1.50	$1.50
Rubber Tile. 50c	50c
Linoleum. (Plain)[2] Light battleship, 18c; B gauge, 17c	17c–25c
Terrazzo. 40c	40c
Vitreous Tile. White, 40c	40c
Concrete. Plain: 25c; colored (with mineral pigment mixed in) 50c	25c–50c

[1]Costs for wood flooring include sub floor, waterproof paper, material, laying, scraping and application of protective layer of building paper, but not the finish. All boards are ⅛ in. thick, 2¼ in. wide, except those used for herringbone pattern, which are ⅞ in. thick and 2½ in. wide; and the maple, which is ⅝ in. thick, and 2¼ in. wide. Labor and material are included for each of the other floorings. pt 32

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Preventing Cracks in New Wood Floors—Leaflet 56, by L. V. Teesdale. 5c from Supt of Docs. 5 pp., illus. Washington: U. S. Dept. of Agric., 1930. Covers proper handling of wood, up to time of occupancy of house, so as to prevent the development of cracks in new wood floors.

Floors and Their Surfaces—Ext. Ser. Bul. 169 (*reprint*), by Helen C. Spaulding. Free. 7 pp. Orono, Maine: College of Agric., Univ. of Maine, Jan. 1928. Describes the preparation of old or new wood floors for finishes, and gives directions for the application and care of various possible finishes.

Floors—Their Finish and Care—Ext. Ser. Bul. 49, by Mrs. Marion C. Bell. Free. 16 pp., illus. New Brunswick, N. J.: N. J. State College of Agric., Dec. 1925. A valuable pamphlet giving formulæ and directions for finishing wood floors; preparations and directions for covering floor with linoleum.

Floors and Floor Coverings—Farmers' Bul. 1219. Free. 36 pp., illus. Washington: Dept. of Agric., Sept. 1921. Discusses common floor finish materials and floor coverings, their treatment, care, and advantages or disadvantages.

Consumers' Research Handbook of Buying, Vol. VII, Part 1, March 1932. 35c to CR subscribers who have not received it as current material due to them. General information and brand name recommendations on floor cleaning and finishing materials and methods.

[2]Thicknesses and weights for linoleum are only approximate, as manufacturers have not standardized the use of grade terms; e. g., the A gauges of two manufacturers were 0.118 in. and 0.142 in., respectively, in 1928. g 29

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