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S. P. MILLER

2,212,122

ROOFING

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Fig. 1,

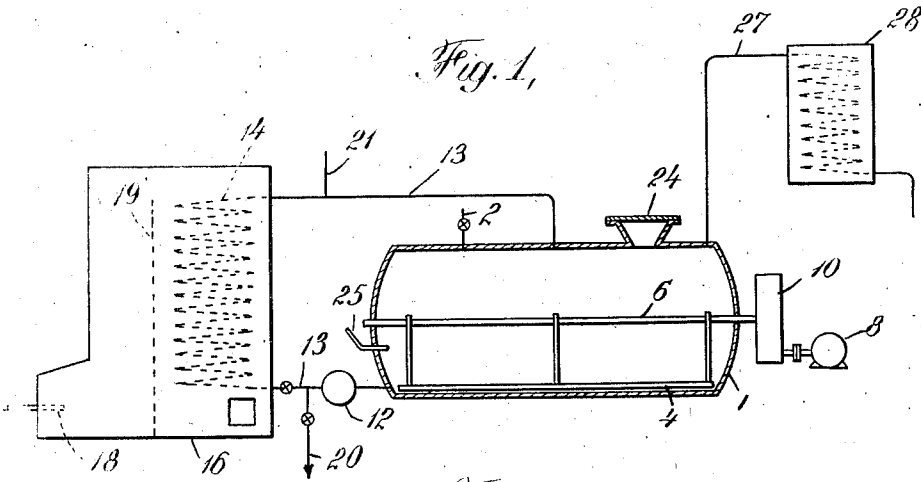


Fig. 2,

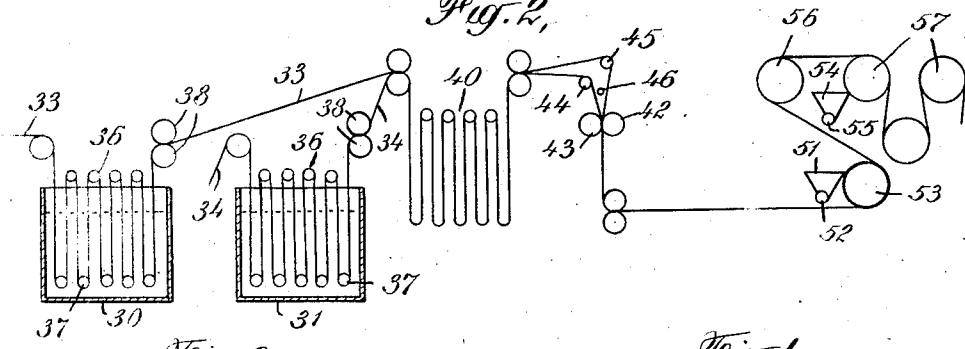


Fig. 3,

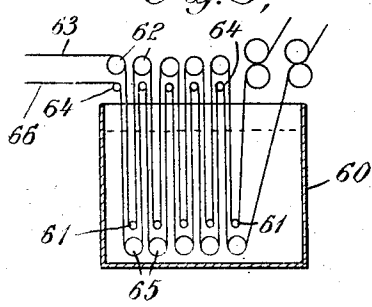


Fig. 4,

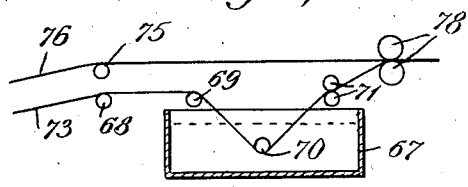


Fig. 5,

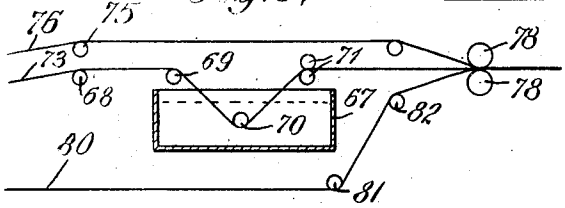
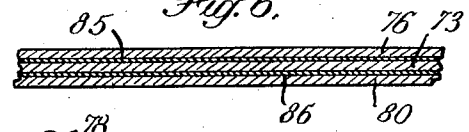


Fig. 6,



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2,212,122

ROOFING

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2 Claims. (Cl. 154—51)

This invention relates to roofing and more particularly to flexible, multi-ply, felt base roll roofing.

Felt base roll roofing which, as is well known, is manufactured and rolled into rolls at the factory and shipped to points of use, should be sufficiently pliable to permit unrolling and laying throughout a wide range of atmospheric temperatures, e. g. temperatures ranging from about 0° to 60° C., without cracking or breaking and should not bleed or become unduly soft or soggy at the highest temperatures encountered in storage and use, e. g. temperatures of 70° C. or higher. Multi-ply roofing, constituted of two or more plies of bitumen-saturated felt cemented together with layers of bituminous cement has presented special problems in the roofing field; owing to its laminated structure and greater thickness than single-ply roofing, difficulty has been experienced in producing multi-ply roofing sufficiently pliable so that it can be laid without cracking, breaking or separation of the plies in cold weather and without bleeding or becoming soggy and tacky in hot weather. Heretofore, multi-ply, felt base, roll roofing has been made by saturating felt sheets with bitumen such as tar or asphalt and cementing together two or more of the saturated sheets with coal tar pitch or asphalt to form a single laminated multi-ply sheet, which is then wound up into rolls. Multi-ply roofing in which a coal tar pitch cement is employed, if the cement is hard enough not to run under hot-weather conditions, becomes objectionably brittle at low atmospheric temperatures and frequently cracks, breaks and shows separation of the plies when laid in cold weather due to the relatively high susceptibility to temperature changes of the coal tar pitch cement; on the other hand, if the cement is soft enough not to crack under cold-weather conditions, it softens and bleeds from between the plies under high temperature conditions frequently encountered during storage, shipment and use in hot weather. It has also been found that high summer temperatures cause multi-ply roofing containing asphalt cement of sufficiently low melting point to possess the necessary pliability for low temperature laying, to soften and become tacky with consequent objectionable softening and sogginess of the roofing. It is an object of this invention to provide multi-ply, felt base, roll roofing sufficiently pliable so that it may be unrolled and laid at low atmospheric temperatures without cracking or separation of the plies and which does not bleed or become soggy when subjected to the highest tem-

perature conditions normally encountered in use, storage and shipment. Other objects and advantages of the invention will appear hereinafter.

In accordance with my invention, I saturate two or more sheets of felt base roofing material with a bituminous waterproofing saturant, preferably coal tar, and cement the sheets together with a cement constituted of coal-digestion pitch, preferably of a softening point (ring and ball) falling within the range of about 140° to 170° F. The cement preferably has a maximum penetration at 46.1° C., 50 grams, 5 seconds of 200, a minimum penetration at 0° C., 200 grams, 60 seconds of 15, and a penetration at 25° C., 100 grams, 5 seconds falling within the range of about 35 to 80. The coal-digestion pitch cement is produced by the digestion of coal with coal tar, water gas tar or a mixture of such tar and tar distillate under conditions such that decomposition of the coal occurs (as evidenced, for example, by gas and water evolution) and the non-ash constituents of the coal form a homogeneous blend with the tar. The non-ash constituents referred to include fusain or mineral charcoal; substantial amounts of the mineral ash constituents may also be and usually are dispersed in my cement, the proportion depending somewhat on the physical form of the ash and the digestion conditions.

I have found that roofing constituted of a plurality of plies of bitumen-saturated felt cemented together with coal-digestion-pitch cement in accordance with the invention is sufficiently pliable so that it may be unrolled and laid without cracking or separation of the plies at low atmospheric temperatures and does not bleed at the highest atmospheric temperatures encountered in storage and use.

In order that my invention may be more fully understood, I shall describe an embodiment thereof in connection with the accompanying drawing, wherein

Fig. 1 is a view illustrating somewhat diagrammatically one form of apparatus which may be employed in producing coal-digestion pitch cement for use in my multi-ply roofing,

Fig. 2 is a diagrammatic view of apparatus which may be employed in carrying out the invention,

Fig. 3 is a view in side elevation showing a modified form of saturating apparatus,

Fig. 4 is a side elevation of a modified form of cementing apparatus,

Fig. 5 is a view in side elevation of a further modified form of cementing apparatus, and

Fig. 6 is a sectional view through roofing in accordance with the invention.

For purposes of exemplification, I have shown in Fig. 1 an apparatus which may be employed for producing coal-digestion pitch cement for my multi-ply roofing involving tank 1 equipped with valved tar or oil inlet 2, oscillating stirrer 4 mounted on oscillating shaft 6, which shaft is journaled in the ends of tank 1 and is driven from motor 8 through oscillating gears illustrated diagrammatically at 10. Reference numeral 12 designates a pump situated in circulating conduit 13 provided with coils 14 located in furnace 16, equipped with a liquid or gaseous fuel burner 18 and baffle 19. Pitch outlet 20 is connected to circulating conduit 13. A thermometer 21 is located in the conduit near the outlet end of coil 14. Tank 1 is equipped with coal charging door 24, thermometer 25, and vapor outlet conduit 27 communicating with a condenser 28.

Coal-digestion pitch may be produced by heating, while agitating, bituminous coal, for example, commercial steam coal and certain commercial non-coking coals, in intimate contact with coal tar, water gas tar or a mixture of such tar and tar distillate under elevated temperature conditions so that the non-ash constituents of the coal including the fusain or mineral charcoal are blended homogeneously with the tar or tar products in which the coal is digested. The temperature to which the coal and tar or tar distillate are heated may vary but in general the temperature is around 300° C., say from about 270° to 340° C. The heating period in practice may vary depending upon the quantity of material in the heating vessel, the efficiency of the stirring apparatus, the fineness of coal, and the amount of heating surface, etc. In lieu of a still equipped with a heating coil a direct fired digesting apparatus, e. g. apparatus involving a digestion tank such as tank 1 equipped with suitable fuel burners located therebeneath, may be employed; alternatively the tar and tar distillate may be repeatedly circulated by means of a pump and conduit system from a heating tank through a digestion chamber containing the coal and thence back to the heating tank.

Products especially adapted for use as the cement for the roofing of this invention should contain in general from 15 to 30 percent of coal; the proportions of coal used may vary depending on the particular type of coal employed and also the character of the tar or tar oil employed. A coal-digestion pitch cement which has been found suitable for this purpose has the following characteristics:

Softening point (ring and ball), °F.....	149
Penetration 46.1° C., 50 grams, 5 seconds.....	158
Penetration 25° C., 100 grams, 5 seconds.....	67
Penetration 0° C., 200 grams, 60 seconds.....	34
Specific gravity 25° C.....	1.209
Insoluble in carbon disulphide, per cent....	26.5
Ash, per cent.....	1.6

Softening points and penetrations are determined in accordance with procedure (using standard apparatus) prescribed by the American Society for Testing Materials. The specific gravity of the coal-digestion pitch cement at 25° C. is not below 1.2 and a minimum of about 18 per cent by weight of the cement is insoluble in carbon disulfide.

The following example will illustrate the general characteristics of coal-digestion pitch cement for the formation of roofing in accordance with the present invention: A mixture of approximately 18 parts by weight of dehydrated coke oven tar and 60 parts by weight of coal tar heavy oil, the bulk of which boils above 235° C., is introduced into the tank 1 through inlet 2 and circulated by pump 12 through conduit 13 until the temperature of the tar in the tank reaches 150° C. or somewhat higher and the agitator 4 started running. About 22 parts by weight of bituminous coal is then added, preferably in pulverized condition, through charging door 24 and the furnace fire regulated to heat the contents of the still rapidly to a temperature of from about 215° to 240° C. The furnace fire is then regulated to raise the temperature gradually, preferably at a rate of from 5° to 10° C. per hour, until the contents of the tank reach a temperature of about 300 C. or higher, depending upon the character of coal used. The mixture in the tank is maintained at a suitable temperature until the non-ash constituents of the mixture, including the fusain or mineral charcoal, form a homogeneous blend with the coal tar and heavy oil to produce coal-digestion pitch of the desired softening point and other characteristics; a substantial fraction of the ash constituents is usually simultaneously permanently dispersed in the product. Operation of the agitator and pump is then stopped and the contents of the still permitted to settle for an hour or more to remove coarse material, e. g. slate which has not been disintegrated and dispersed during digestion. The coal-digestion pitch products may be withdrawn from the tank through valved outlet 20. Vapors escaping through line 27 may be cooled and recovered by means of condenser 28. Substantial evolution of gas and water vapor during digestion indicates substantial decomposition of the coal.

Referring more particularly to Fig. 2, reference numerals 30, 31 denote saturating kettles containing molten coal tar or other suitable bituminous saturant, into which felt sheets 33, 34 are repeatedly immersed as they pass over kettle rolls 36, 37. Upon emerging from the tank, excess saturant is squeezed from the sheets by squeeze rolls 38 and they are then passed to looping rack 40 where they are given an opportunity to cool. As the saturated sheets are fed from the looping rack to compressing rolls 42, 43 they are separated by guide rolls 44, 45 and molten coal-digestion pitch cement is introduced into the angle between the sheets from spout 46 located within the angle between and extending across the entire width of the sheets. During passage of the felt sheets between rolls 42, 43, they are pressed together by the rolls and firmly bonded together by the coal-digestion pitch cement. The resultant multi-ply roofing may be rolled into rolls directly or, if desired, a small amount of fine sand, talc, mica, sawdust or other suitable material may be distributed over the sheet to prevent adhesion of adjacent layers before rolling it into rolls; for this purpose hoppers 51 and 54 with distributing rolls 52 and 55 may be used, the felt being passed over rolls 53, 56 and 57 in the way well known in the art.

In Fig. 3 there is shown a modified form of saturating apparatus which may be employed in lieu of the two saturating kettles of Fig. 2 and which involves a single saturating kettle 60 equipped with a set of kettle rolls 61, 62 over

which felt sheet 63 passes and another set of kettle rolls 64, 65 over which felt sheet 66 passes. It will be observed that the two sets of kettle rolls define two separate paths for passage of the two felt sheets through the saturant so that two sheets may simultaneously be saturated in the same kettle.

Fig. 4 illustrates a modified form of cementing apparatus involving a tank 67 containing molten coal-digestion pitch cement, guide rolls 68, 69, 70, 71 over which the felt sheet 73 runs as it passes into and through the cement in the tank, guide roll 75 over which saturated felt sheet 76 passes, and compressing rolls 78 for firmly pressing the sheets 73 and 76 together and causing them to be adhered by the coal-digestion pitch cement to form a single laminated multi-ply sheet. Rolls 71 may function as squeeze rolls to remove excess cement from the sheet 73 before it is brought into contact with sheet 76.

In Fig. 5 there is shown apparatus which may be employed for producing triple-ply roofing. This apparatus differs from the apparatus of Fig. 4 chiefly in that it involves rolls 81, 82 which guide a third saturated sheet 80 between compressing rolls 78 where it is cemented to the lower face of sheet 73 to form triple-ply roofing such as illustrated in Fig. 6. This roofing, it will be observed, involves upper saturated felt ply 76 cemented to intermediate ply 73 by layer 85 of coal-digestion pitch cement and lower saturated felt ply 80 cemented to the intermediate ply by layer 86 of coal-digestion pitch cement. Three-ply roofing may also be manufactured by passing three sheets of saturated felt between rolls 42, 43 and applying the coal-digestion pitch cement between both of the outer plies and the inner ply, e. g. by two spouts such as shown at 46 in Fig. 2. If desired, suitable fillers may be incorporated in the coal-digestion pitch cement before applying it to the roofing.

Multi-ply roofing, in accordance with the invention, may vary widely with respect to the weights of its component parts, depending on their composition, e. g. whether asbestos is included in the felt constituents. In general two-ply rag-felt roofing should fall within the following approximate limits when its composition is expressed as pounds per 108 square feet: 6 to 12 pounds of felt; 6.5 to 17 pounds of saturant; 12 to 24 pounds of coal-digestion pitch cement. For example, a two-ply roofing of the following composition has been found satisfactory: felt 8.5 pounds; saturant 9.5 pounds; coal-digestion pitch cement 15 pounds; fine sand dusting 3 pounds. In general three-ply roofing should fall within the following approximate limits: 9 to 18 pounds of felt, 10 to 25 pounds of saturant, 24 to 48 pounds of coal-digestion pitch cement. Three-ply roofing of the following composition has been found satisfactory: felt 12.7 pounds; saturant 14.3 pounds; coal-digestion pitch cement 24.5 pounds; fine sand dusting 3 pounds.

Multi-ply roll roofing embodying this invention constituted of a plurality of plies of bitumen-saturated felt sheets made from usual furnishes which usually consist of rag and paper fibers, but may contain other animal and vegetable fibers as well as mineral fibers such as asbestos, the

felt sheets being cemented together with coal-digestion pitch cement, I have discovered, is sufficiently pliable so that it may be unrolled and laid over a wide range of atmospheric temperatures, e. g. temperatures of from 0° to 60° C., without cracking or separation of the plies, and does not bleed at the highest atmospheric temperatures encountered in storage and use, e. g. temperatures around 70° C. No objectionable sogginess or softening of the roofing is encountered during hot weather.

The term "roofing" is used in the specification and claims in a broad sense and is intended to include coverings for walls and other surfaces as well as coverings for roofs.

Since certain modifications may be resorted to without departing from the spirit of my invention—for example: asphalt may be used as saturant instead of coal tar; the roofing may be coated with bitumen and surfaced with mineral granules; the multi-ply roll roofing may be cut into shingle or siding elements—the above description should be interpreted in an illustrative and not in a limiting sense.

I claim:

1. Multi-ply roll roofing of a pliability such that it may be stored, unrolled and laid throughout a wide range of atmospheric temperatures without cracking or bleeding comprising a plurality of plies of bitumen-saturated felt cemented together in face-to-face relation with a product obtainable by heating together bituminous coal and a material of the group consisting of water gas tar and coal tar and their distillation products to a temperature such that substantial decomposition of the coal occurs and the non-ash constituents of the mixture behave as a homogeneous blend, said product having a softening point of from about 140° to 170° F., a penetration at 46.1° C., 50 grams, 5 seconds of not greater than 200, a penetration at 25° C., 100 grams, 5 seconds of about 35 to 80, and a penetration at 0° C., 200 grams, 60 seconds of not less than 15.

2. Multi-ply roll roofing of a pliability such that it may be stored, unrolled and laid throughout a wide range of atmospheric temperatures without cracking or bleeding comprising a plurality of plies of bitumen-saturated felt cemented together in face-to-face relation with a coal-digestion pitch cement obtainable by heating together bituminous coal and a material of the group consisting of water gas tar and coal tar and their distillation products to a temperature between 270° and 340° C. for a period of time such that substantial decomposition of the coal occurs and the non-ash constituents of the mixture behave as a homogeneous blend, said coal-digestion pitch cement having a softening point (ring and ball) of from about 140° to 170° F., a penetration at 46.1° C., 50 grams, 5 seconds of not greater than about 200, a penetration at 25° C., 100 grams, 5 seconds of from about 35 to 80, and a penetration at 0° C., 200 grams, 60 seconds of not less than about 15, said coal-digestion pitch cement having a specific gravity at 25° C., not below 1.2 and a minimum of about 18 percent by weight of the cement being insoluble in carbon disulfide.

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