first enumerate and explain the composition of the materials generally used for these joints, then point out their special advantages and the most advantageous situation to use each one.

Asbestos millboard, paper pulp and asbestos fibre, hard vulcanized rubber rings and soft sheet rubber, rubber "insertion," composed of alternate layers of vulcanized rubber and canvass; wire gauze "insertion," fine brass wire gauze, having a layer of vulcanized rubber on each side; wire gauze and "putty," fine brass wire gauze and red-lead putty—i. e., equal parts red and white lead; hard lamp-wick, same as that used for petroleum lamps; soft hempen "spun yarn" and "putty," soft lead wire, gutta percha rod and rings.

Now for the best places to use these materials, so as to take advantage of each one's special properties.

We will take the case of the high-pressure steam-cylinder cover joint. This requires a material that will stand great heat and pressure, yet it must leave the flange faces readily, so as to to lift the cover easily for inspection or repairs to piston, etc. The joint must last a fairly long period, as these large rings are expensive. Asbestos millboard is found to be the best substance to use for this class of joint, solid rings to cover the whole of the flange faces, said rings to be punched with holes for the studs, which hold cover in place. These asbestos rings, if carefully smeared with a mixture of plumbago and tallow or rubbed with plumbago alone, on each side to keep them from adhering to the joint faces, will last for a long time, during which the cover may be lifted many times if the joint is carefully removed and rubbed with the plumbago or plumbago and tallow before replacing. Solid rings of hard vulcanized rubber are sometimes used instead of the asbestos, but they do not last so long or answer so well. Hard lamp-wick may be used in an emergency if either of the above are not at hand. Red lead "putty" is sometimes used, but it is *very* difficult to remove the cover—the putty setting so hard, and there being such a thin layer of it. So that if great care is not used when driving the small steel wedges used to break the joint, the cover itself may be cracked.

Never make cylinder-cover joints with "putty" unless you have nothing else at hand. Slide valve cover joints are made in the same manner as those of cylinder covers. The joints may be cut out of the solid or composed of strips dove-tailed together at the corners. Asbestos is commonly used, but the remarks made *re* horse power cylinder covers apply to slide-valve covers as well.

Low pressure steam cylinder cover joints may be made with hard lamp wick soaked in paint or cylinder oil. Soft lead wire, turned into a ring and the ends soldered together, is sometimes used. Of course asbestos millboard can be used if the expense is not objected to, but it is quite unnecessary, as the heat and pressure in the low-pressure cylinder are very low.

The materials used for steam-pipe joints should vary according to the locality of the joint, style of flanges, etc. The best flanges for the smaller steam pipes are those known as "hydraulic" or "spigot" flanges. These have a recess in one face and a corresponding projection on the other to fit in the recess, but the projection must be longer than the recess is deep, so that when the jointing material is in place the outer faces of the flanges do not come in contact. Solid asbestos rings are generally used with these flanges if they are made of the same metal, both copper or both iron.

The plain flange as commonly met with is used for steam piping, both large and small. Greater care is required in making a joint with these flanges than with the "hydraulic" or "spigot" flanges as the walls of the recess in the latter keep the asbestos from being blown from between the flanges, if from any cause the tension on the bolts is slackened. Plain flanges having a large number of small bolts are preferable to those having a few large ones, as the pressure on the flanges is more equally divided, and they are not thrown out of shape so much as when the bolts are wider apart. In situations where very little water collects asbestos millboard can be used with advantage, if there is very little water present and both the flanges are of the same metal. Asbestos millboard should *never* be put between copper and iron—such as between flange of stop valve casting on boiler and main steam pipe to engines; the former is usually of cast iron and the latter of copper. I have known the cast-iron face of such a joint to be deeply pitted owing to the electrical action set up between the copper and iron, having a porous diaphragm of asbestos soaked with condensed water between them, thus forming a "constant battery."

Wire gauze and red-lead "putty" are materials to use in such a case. "Rubber insertion" is used where the joint is fairly easy of access, so as to screw up the nuts as the rubber becomes softened by the heat. This must be done until there is a good strain on the bolts and nuts. Of course the "insertion" is to be well greased with tallow and plumbago before using and the flange faces cleaned and filed flat where practicable.

Where a joint is in such a position that it can only be made when steam is down, the best plan is to use brass wire gauze and red lead "putty." All cocks on the boiler should have this joint. Having tried many substances I find none equal to the old plan—used many years on locomotive engines—of "gauze and putty" for all plain flange joints that do not require breaking frequently and have to endure high pressure and great heat in the presence of water. To make joint last the longest possible time two thicknesses of brass wire gauze should be used having the holes punched out for the bolts, the center hole for the steam to be cut with scissors. Each side of the pieces of gauze should be covered with a thin layer of stiff "red-lead putty," the faces of flanges being thoroughly cleaned, the "gauze and putty" placed in position and the nuts screwed hard down; if the joint is allowed to harden a little before the pressure comes on it, it will not require removing for years.

For pump cylinder covers, valve covers and all plain-flanged joints for water under pressure, wire gauze insertion, or failing that, ordinary "rubber insertion." All rubber and asbestos to be well rubbed with plumbago or plumbago and tallow before putting between the flanges to prevent it sticking to them. Joints in pipes conveying water under heavy pressure, say 600 or 700 lb. per sq. in., have the before mentioned "hydraulic" flanges having the recess and projection; in the recess is placed a ring of guttapercha about $\frac{1}{4}$ in. thick. These rings are very simply made from $\frac{1}{4}$ in. rod, long enough to form the sized ring required, and a little over for lap of the joint: if the ends are now heated in a lamp and pressed together, the ring is quickly made. In use the rings flattens out, owing to the pressure of one flange against the other by the pull of the bolts and coming against the outer rim of the recess is there stopped, thus making a capital joint for resisting cold water under heavy pressures. Manhole and mudhole joints on boilers should be made with oval rings of hard vulcanized rubber of the required dimensions; not having these at hand, rings formed of rubber—square in cross-section—can be used. The square rubber is cut to the length required, with sufficient over for making a scarfed joint of about 2 in. long the ends are scarfed, put together and tied with sewing twine temporarily, now tried on the door, and, if a good fit, then the scarf is "served" with sewing twine, wound closely together, and the ends fastened with a knot. This makes a good joint for pressures up to 100 lb. per sq. in. If required two rings can be used, placed one outside the other, with the joints on opposite sides of the door. Supposing we have no rubber at all then hempen "spun yarn" can be used, rubbed with stiff white lead. This makes a fairly efficient joint for pressures up to 60 lb. per sq. in. It may stand higher than this, but I have not tried it for above 60 lb.