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HOT TOP COMPOSITION FOR CASTING MOLDS

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3 Claims. (Cl. 249—197)

This appplication is a continuation of our application Serial No. 319,944 filed October 29, 1963, now abandoned.

The present invention relates to hot tops for casting molds for casting steel or other metals and especially to hot tops for ingot molds, said hot tops having high head insulation ability and low heat capacity and each forming a relatively thin insulating layer between the cast metal and an outer supporting structure. The hot top is often placed within the upper part of the mold and supported by the walls of the mold, in which case it is preferably composed of separate slabs. A hot top can also be placed on top of the ingot mold and supported by a separate supporting sleeve, in which case it suitably has the shape of an upwardly tapering unitary hood. These and other applications of the hot tops of the invention for casting purposes are possible.

The invention relates especially to hot tops containing a refractory finely grained material mixed with a minor part of organic, preferably fibrous material, a binder, usually glue and possibly a fibrous refractory material.

The general purpose of hot tops in casting molds is to delay the freezing of the cast metal. Especially in ingot castings it is important to delay the freezing of the top part of the casting in order to limit pipe formations and segregations as close as possible to the top surface of the ingot. For this purpose a hot top should have good heat insulating properties and preferably also a low heat capacity. It should further have a sufficient mechanical strength to avoid breakage in storing and handling. It must be heat resistant so that it does not break and parts thereof mingle with the casting metal. It is also important that the hot top has a composition that causes as little internal gas formation within the hot top as possible.

The present invention involves an improvement upon earlier known hot tops in the mentioned respects and a hot top according to the invention has the following composition ranges in percent by weight based upon the dry substances: 3–30% of organic, heat insulating preferably fibrous material such as paper pulp, 1–20% of a binder, preferably glue such as organic glue, up to 10% of fibrous refractory material such as asbestos, 40–93% of fine grained, at least substantially refractory and relative non-porous material having a bulk density in uncompacted dry condition above 0.5 kg./liter such as olivine, silica, silicates, oxide of magnesium, slag and the like and 2–60% of at least substantially refractory fine grained material, the grains of which are porous and heat insulating and have a bulk density in uncompacted dry condition below 0.5 kg./liter such as infusorial earth, vermiculite and the like.

In order to obtain the desired results it is important that the composition falls within the above ranges. The invention relates especially to the effect of the porous refractory material, which has been found to have a remarkable influence upon the desired low heat conductivity and low heat capacity.

It is to be noted that the bulk density of the fine grained refractory material, both the heavier and the lighter fraction thereof, is determined with relation to the property of the material before the manufacture of the hot top and before it has been mixed with any other material. To determine said density it is assumed that the material is measured in the condition obtained when it is poured freely into a receptacle without any packing, the material being dry.

In order to maintain the content of organic, combustible material in the main similar for different hot tops having different relations between the heavy and light refractory materials, the relative weight of the combustible material should be larger in compositions in which the quantity of the lighter refractory material is greater in relation to the heavier refractory material. This means that the percent ranges for the organic material will come closer to their upper limits, if the quantity of porous refractory material is relatively large.

As mentioned the light, porous refractory material should have a bulk density not exceeding 0.5 kg./liter for dry, unpacked material. As a rule the bulk density should be less than 0.3 kg./liter and often less than 0.2 kg./liter. We have found infursorial earth as diatomaceous earth of kieselguhr, consisting of small, porous grains and having a bulk density less than 0.2 kg./liter to be suitable for this purpose. Other similar refractory and heat-insulating materials having porous grains are vermiculite, certain porous slags and materials having an artificially produced porosity such as silica light stones, zirconia light stones and the like. The content of refractory porous material should be within the limits 2–60%. The quantity should preferably with regard to the usually relatively high cost of this material, be held in the lower part of said range, i.e. 2–20% and preferably 3–15%.

As the fine grained heavy refractory material olivine, silica, silicates, oxide of magnesium, fly ash, slags, ball mill dust and other material having a bulk density above 0.6 kg./liter, generally above, 0.8 kg./liter and often above 1.0 kg./liter can be used. Certain materials such as blast furnace slag are not completely refractory within the actual temperature range but have a sufficient heat resistance for the present purpose. As an example of ball mill dust can be mentioned the ball mill dust obtained in aluminum manufacture. The heavy material is in general non-porous or has substantially no porosity. The quantity of this material should be 40–93%. A suitable range is 60–90%, preferably 70–90%.

By the word "refractory" we mean materials having a sufficiently high melting point to maintain the hot top in a rigid shape and in position to fulfill its function during the casting. In general the materials mentioned have melting points above the actual temperatures encountered in use but in certain cases a somewhat lower melting point can be allowed for at least one of the refractory fine grained ingredients, especially if the casting time is short.

The invention involves as above explained the use of two kinds of refractory, fine grained materials, one having a relatively high bulk density and grains with none or only a small porosity, the other having a relatively low bulk density and porous grains. The difference in specific weight between the two kinds of refractory materials may be little or none at all, the porosity of the grains determining the smaller bulk density in the lighter material. The grains of the heavier material are less heat insulating than the porous grains of the lighter material, but on the other hand the heavier grains have a greater mechanical strength. Thus the two fractions of the refractory fine grained material cooperate in giving the hot top a good heat insulation and mechanical strength.

The composition should further contain a suitable quantity of heat-insulating organic material, usually having a fibrous structure. Suitable fibrous materials are paper, paper pulp, finely ground waste paper and the like.

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Also finely divided saw dust and non-fibrous materials as for instance cork can be used. The content of this material should be 3–30%, generally 4–15% and preferably 4–12%.

In order to hold the constituents of the lining together a binder is added, usually a glue such as a synthetic or natural resin glue, which can be of a hardenable type. If the glue is hardenable, the hardening can be performed in connection with the drying of the hot top. The quantity of binder should be 1–20%, generally 2–10% and preferably 2–6% dry weight.

It is often suitable to use a certain amount of fibrous, refractory heat insulating material such as asbestos, rock wool or the like in order to increase the coherence and mechanical strength of the hot top. This ingredient can amount to up to 10%, generally up to 5% and preferably within the range 0.5–4%.

A hot top according to the invention can for instance have the following composition: 3–15% of fine grained refractory porous material, 72–87% of fine grained heavier refractory material, 4–10% of organic fibrous material, 2–8% of glue and up to 5% of fibrous refractory material. Other examples of linings according to the invention are: (I) 10% of diatomaceous earth, 8% of ground paper, 5% of glue, 2% of asbestos and 75% of olivine. (II) 15% of diatomaceous earth, 9% of ground paper, 4% of glue, 1% of asbestos and 71% of olivine. (III) 5% of diatomaceous earth, 7% of ground paper, 3% of glue, 1.5% of asbestos and 83.5% olivine. (IV) 50% of diatomaceous earth, 5% of glue, 10% of paper pulp, 3% of asbestos and 32% of olivine. The glue ingredient in each of the foregoing examples may be a natural glue or a synthetic resin glue, such as liquid urea formaldehyde resin or phenol formaldehyde resin or carbamide resin.

In manufacturing the hot top the ingredients are thoroughly mixed together and formed to the desired shape. The forming is suitably performed by mixing the ingredients with a liquid, suitably water, to a slurry, which is filtered on a filter mold having the shape of the lining to be made. The filtering should preferably take place under pressure or suction. The slurry solids deposit on the filter, and when the deposition has reached the desired thickness the cake formed by the deposition is removed from the filter and dried. It would also be possible to press the ingredients to a cake without the filtering process, but the making of a slurry and filtering it has been found more convenient.

For special purposes the composition can be given an improved ability to delay the freezing of the metal by adding a heat-developing ingredient, thus not only relying upon the heat insulating property of the hot top but making it also a source of heat. For this purpose an exothermic composition can be added to the above mentioned heat-insulating composition. The exothermic composition can for instance comprise an easily oxidizing material such as aluminum, an oxidizing agent such as oxide of manganese or iron and possibly also an igniting substance such as a fluoride. This exothermic composition should be added preferably in rather small quantities, for instance 10% by weight of the heat insulating composition.

The heat insulating properties of the hot top according to the present invention have in combination with other suitable properties, especially the high mechanical strength, made it possible to use very thin slabs in hot tops for ingot molds. The thickness can be within the range 6–30 mm., usually 8–20 mm., the thickness depending upon the size of the ingot. The eminent heat insulation obtained by the invention is illustrated by the fact that a hot top as thin as above mentioned can rest against the sides of an ingot mold or a cast iron sleeve placed on top of an ingot mold and be supported on its outside

by a good heat conductor such as cast iron and yet provide a sufficient heat insulation for the sink head.

The present invention may be regarded as being an improvement upon or modification of the hot tops described in U.S. Patent No. 3,072,981. Since the present invention does not involve any novel structure drawings are not provided to illustrate the invention. The structures of the hot tops of the present invention may be the same as are disclosed in said patent.

We claim:

1. A hot top for casting molds having a high heat resistance, a high heat insulation ability and a low heat capacity, said hot top being a self supporting structure having a thickness within the range from 6 to 30 mm. and consisting essentially of a homogeneous composition of from 4 to 12% by weight of a finely divided organic, heat-insulating fibrous material selected from the group consisting of paper and paper pulp, from 2 to 8% dry weight of an organic glue, from 0.5 to 4% by weight of asbestos, from 70 to 90% by weight of a fine grained substantially non-porous, refractory material having a bulk density in its uncompacted dry condition greater than 0.5 kg./liter selected from the group consisting of olivine, silica, silicates, magnesium oxide, slags, fly ash and ball mill dust and from 3 to 15% by weight of a fine grained, porous refractory material having a bulk density in its uncompacted dry condition of less than 0.3 kg./liter selected from the group consisting of infusorial earth, vermiculite, diatomaceous earth and kieselguhr.

2. A hot top as defined in claim 1 in which the fine grained substantially non-porous refractory material is olivine and the fine grained, porous refractory material is diatomaceous earth.

3. A hot top for casting molds having a high heat resistance, a high heat insulation ability and a low heat capacity, said hot top being a self supporting thin-walled structure and consisting essentially of a homogeneous composition of from 4 to 12% by weight of a finely divided organic, heat-insulating fibrous material selected from the group consisting of paper and paper pulp, from 2 to 8% dry weight of an organic glue, up to 10% by weight of refractory fibrous material, from 70 to 90% by weight of a fine grained substantially non-porous, refractory material having a bulk density in its uncompacted dry condition greater than 0.5 kg./liter selected from the group consisting of olivine, silica, silicates, magnesium oxide, slags, fly ash and ball mill dust and from 3 to 15% by weight of a fine grained, porous refractory material having a bulk density in its uncompacted dry condition of less than 0.3 kg./liter selected from the group consisting of infusorial earth, vermiculite, diatomaceous earth and kieselguhr.

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