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2,887,392

**METAL CONTAINING PATTERNS AND METHOD OF PRODUCING SAME****William H. Lolley, New York, N.Y.; Barbara Lolley, administratrix of said William H. Lolley, deceased****No Drawing. Application August 27, 1956  
Serial No. 606,196****14 Claims. (Cl. 106—38.3)**

This invention relates to novel metal containing patterns and the like and to a novel method for producing the same. The invention also includes novel compositions of matter for use in the production of said novel patterns. The term pattern as used herein is meant to include (1) patterns, core boxes and the like for use in the foundry industry in producing molds, including shell molds, cores and the like from which the desired metal casting is produced; (2) dies and the like for use in the plastic industry from which the desired plastic article is formed and produced; and, (3) molds for use in sintering powdered metal into a solid finished article.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the steps, methods, combination and improvements, compositions of matter pointed out in the appended claims.

The invention consists in the novel steps, methods, combinations and improvements, compositions of matter herein described.

An object of this invention is to provide a novel method for the production of patterns and the like which is simple, efficient and much more economical than the heretofore used methods.

Another object of this invention is to provide novel patterns and the like of high dimensional and structural stability, good thermal conductivity and high surface smoothness.

A still further object of this invention is to provide novel compositions of matter for use in the production of novel patterns and the like having the attributes set forth in the foregoing object.

In the conventional foundry processes today, the following procedure is generally used in making a metal pattern. A detailed drawing is made of the object to be formed by casting. A pattern maker then makes a wood pattern in view of the drawing. The wood pattern is then taken to the foundry where a sand mold is made from the wood pattern. The sand mold is then used in making a metal casting by filling the pattern imprint in the sand mold with molten metal and the metal on solidifying forms a rough metal casting which is then taken to a tool room, where a tool maker machines all surfaces of said metal casting to close dimensional accuracy and a glass like finish which results in the desired metal pattern being formed. The time required for this machine operation is unduly long and expensive; the time depending upon the complexity of the pattern. From 100 to 1000 hours is required in many cases. The pattern is then used in forming the conventional sand mold or it may be used in forming a shell mold of the plastic bonded type described in the Office of Technical Service F.I.A.T. Report 1168, May 30, 1943, found in the Dept. of Commerce and illustrated in an article by Ames et al. in the August 1950 issue of "The Foundry." In that article, the authors described

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a process for making molds from silica sand (90 to 94%) and 6-10% of a phenol formaldehyde resin to which hexamethylenetetramine was added as catalytic accelerator. These plastic bond shell molds are used in place of the conventional sand molds. The above described process for making a pattern is very expensive, due to the enormous amount of time required in the production thereof. The cost is further increased due to the fact that the pattern is made entirely of metal. It should be understood that the hereinabove described prior method for making a pattern is for the purpose of illustration only and that similar methods presenting like problems and disadvantages have been heretofore used in the production of core boxes for use in the foundry industry, dies for use in the plastic industry and molds for use in the sintering of metals.

In accordance with this invention, patterns and the like are formed by a novel method which is simple, efficient and much more economical than the heretofore known methods.

In general, the novel method of this invention comprises forming a pattern or the like of high dimensional and structural stability, good thermal conductivity and high surface smoothness by the utilization of a novel water settable pattern composition comprising powdered metal or metal alloy or mixtures thereof having high thermal conductivity, high structural stability and adequate hardness and a water settable high temperature binding agent of the type described in detail hereinafter.

More particularly, the metal particles to be useful as a component of the novel pattern composition must possess high thermal conductivity and dimensional and structural stability at the temperatures to which the resulting pattern or the like is to be subjected to in use. In general, patterns and the like produced in accordance with this invention are in use subjected to temperature cycles in the range of 250° F. to 2000° F.+

For example, a pattern useful in the foundry industry for producing shell molds is subjected to varying cyclic temperatures, such as 10-30 seconds at 400-800° F. to form the mold and 600-1200° F. for 30-60 seconds to cure the mold. Accordingly, metal particles to be useful in forming such a pattern for forming shell mold must possess thermal conductivity and both dimensional and structural stability under the indicated temperature cycles.

In addition, the metal particles to be useful in accordance with this invention must possess high thermal conductivity so that resulting pattern or the like in use when heated will cause the investment material to flow readily and uniformly.

Examples of metal particles useful in accordance with this invention are iron powder, steel powder, iron and steel alloy powders such as chrome, nickel and molybdenum alloys, nickel powder and copper powder. Metal powders of low thermal stability such as lead powder, cannot be used in accordance with this invention.

In general, the metal particles used in this invention are of a size in the range of 325— to 16 mesh. Preferably, a mixture of varying mesh sizes are used to suit varying operating conditions and depending upon the desired surface hardness, surface smoothness, dimensional accuracy, resistance to corrosion, ability to be chrome plated, etc. It is preferred that a mixture of metal particles be used so that the number of voids be kept at a minimum in order to insure adequate thermal conductivity. In like manner, a mixture of different metallic particles may be used in order to obtain a pattern having certain characteristics. For example, copper powder may be substituted for a portion of iron powder to increase the thermal conductivity of the formed pattern. Patterns and the like produced in accordance with this invention have been plated-hard chrome with deposits from .0005" to .002",

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It is possible to plate these novel patterns and the like because of their high metallic content and even distribution of the metallic particles. A "hard chrome" plate is found most beneficial in combatting corrosion and acidity such as that encountered in certain plastics production.

Examples of suitable metal powder mixtures are given below in Examples 1-21.

## EXAMPLE 1

| Metal Particles | Mesh No. | Approx. Particle Dia. | Percent plus or minus 2% |
|-----------------|----------|-----------------------|--------------------------|
| Iron.....       | 80       | .0070                 | 24.00                    |
| Do.....         | 120      | .0050                 | 22.00                    |
| Do.....         | 200      | .0030                 | 22.50                    |
| Do.....         | 325      | .0017                 | 13.75                    |
| Do.....         | 325-     | .001-                 | 17.75                    |

## EXAMPLE 2

|           |      |       |       |
|-----------|------|-------|-------|
| Iron..... | 80   | .0070 | 18.75 |
| Do.....   | 120  | .0050 | 17.25 |
| Do.....   | 200  | .0030 | 17.00 |
| Do.....   | 325  | .0017 | 11.00 |
| Do.....   | 325- | .001- | 36.00 |

## EXAMPLE 3

|           |      |       |       |
|-----------|------|-------|-------|
| Iron..... | 80   | .0070 | 12.00 |
| Do.....   | 120  | .0050 | 11.00 |
| Do.....   | 200  | .0030 | 11.25 |
| Do.....   | 325  | .0017 | 7.00  |
| Do.....   | 325- | .001- | 58.75 |

## EXAMPLE 4

|           |      |       |       |
|-----------|------|-------|-------|
| Iron..... | 80   | .0070 | 8.00  |
| Do.....   | 120  | .0050 | 7.25  |
| Do.....   | 200  | .0030 | 7.50  |
| Do.....   | 325  | .0017 | 7.25  |
| Do.....   | 325- | .001- | 70.00 |

## EXAMPLE 5

|           |      |       |       |
|-----------|------|-------|-------|
| Iron..... | 80   | .0070 | 3.25  |
| Do.....   | 120  | .0050 | 3.75  |
| Do.....   | 200  | .0030 | 3.75  |
| Do.....   | 325  | .0017 | 5.25  |
| Do.....   | 325- | .001- | 84.00 |

## EXAMPLE 6

|           |     |       |       |
|-----------|-----|-------|-------|
| Iron..... | 18  | .0400 | 26.00 |
| Do.....   | 80  | .0070 | 12.50 |
| Do.....   | 120 | .0050 | 13.25 |
| Do.....   | 200 | .0030 | 8.25  |
| Do.....   | 325 | .0017 | 40.00 |

## EXAMPLE 7

|           |     |       |      |
|-----------|-----|-------|------|
| Iron..... | 18  | .0400 | 39.4 |
| Do.....   | 80  | .0070 | 12.5 |
| Do.....   | 120 | .0050 | 13.0 |
| Do.....   | 200 | .0030 | 9.5  |
| Do.....   | 325 | .0017 | 25.6 |

## EXAMPLE 8

|           |     |       |      |
|-----------|-----|-------|------|
| Iron..... | 18  | .0400 | 58.9 |
| Do.....   | 80  | .0070 | 12.5 |
| Do.....   | 120 | .0050 | 13.5 |
| Do.....   | 200 | .0030 | 8.5  |
| Do.....   | 325 | .0017 | 6.6  |

## EXAMPLE 9

|           |      |       |       |
|-----------|------|-------|-------|
| Iron..... | 16   | .0500 | 25.00 |
| Do.....   | 20   | .0330 | 12.50 |
| Do.....   | 40   | .0165 | 11.00 |
| Do.....   | 50   | .0117 | 7.00  |
| Do.....   | 70   | .0070 | 6.20  |
| Do.....   | 200- | .0030 | 38.30 |

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## EXAMPLE 10

| Metal Particles | Mesh No. | Approx. Particle Dia. | Percent plus or minus 2% |
|-----------------|----------|-----------------------|--------------------------|
| Iron.....       | 16       | .050                  | 35.50                    |
| Do.....         | 20       | .033                  | 12.50                    |
| Do.....         | 40       | .0165                 | 11.00                    |
| Do.....         | 50       | .0117                 | 9.00                     |
| Do.....         | 70       | .007                  | 6.25                     |
| Do.....         | 200      | .003-                 | 25.75                    |

## EXAMPLE 11

|           |     |       |       |
|-----------|-----|-------|-------|
| Iron..... | 16  | .050  | 51.00 |
| Do.....   | 20  | .033  | 12.50 |
| Do.....   | 40  | .0165 | 11.00 |
| Do.....   | 50  | .0117 | 9.00  |
| Do.....   | 70  | .007  | 6.50  |
| Do.....   | 200 | .003- | 10.00 |

## EXAMPLE 12

|             |      |       |       |
|-------------|------|-------|-------|
| Iron.....   | 80   | .0070 | 24.00 |
| Do.....     | 120  | .0050 | 22.00 |
| Do.....     | 200  | .0030 | 22.50 |
| Copper..... | 200  | .0030 | 13.75 |
| Iron.....   | 325- | .001- | 17.75 |

## EXAMPLE 13

|             |      |       |       |
|-------------|------|-------|-------|
| Iron.....   | 80   | .0070 | 18.75 |
| Do.....     | 120  | .0050 | 17.25 |
| Do.....     | 200  | .0030 | 17.00 |
| Copper..... | 200  | .0030 | 11.00 |
| Iron.....   | 325- | .001- | 36.00 |

## EXAMPLE 14

|             |      |       |       |
|-------------|------|-------|-------|
| Iron.....   | 80   | .0070 | 12.00 |
| Do.....     | 120  | .0050 | 11.00 |
| Do.....     | 200  | .0030 | 11.25 |
| Copper..... | 200  | .0030 | 7.00  |
| Iron.....   | 325- | .001- | 58.75 |

## EXAMPLE 15

|             |      |       |       |
|-------------|------|-------|-------|
| Iron.....   | 80   | .0070 | 8.00  |
| Do.....     | 120  | .0050 | 7.25  |
| Do.....     | 200  | .0030 | 7.50  |
| Copper..... | 200  | .0030 | 7.25  |
| Iron.....   | 325- | .001- | 70.00 |

## EXAMPLE 16

|             |      |       |       |
|-------------|------|-------|-------|
| Iron.....   | 80   | .0070 | 3.25  |
| Do.....     | 120  | .0050 | 3.75  |
| Do.....     | 200  | .0030 | 3.75  |
| Copper..... | 200  | .0030 | 5.25  |
| Iron.....   | 325- | .001- | 84.00 |

## EXAMPLE 17

|             |     |       |       |
|-------------|-----|-------|-------|
| Iron.....   | 18  | .0040 | 26.00 |
| Do.....     | 80  | .0070 | 12.50 |
| Do.....     | 120 | .0050 | 13.25 |
| Do.....     | 200 | .0030 | 8.25  |
| Copper..... | 200 | .0030 | 40.00 |

## EXAMPLE 18

|             |     |       |      |
|-------------|-----|-------|------|
| Iron.....   | 18  | .0040 | 39.4 |
| Do.....     | 80  | .0070 | 12.5 |
| Do.....     | 120 | .0050 | 13.0 |
| Do.....     | 200 | .0030 | 9.5  |
| Copper..... | 200 | .0030 | 25.6 |

## EXAMPLE 19

|             |     |       |      |
|-------------|-----|-------|------|
| Iron.....   | 18  | .0400 | 58.9 |
| Do.....     | 80  | .0070 | 12.5 |
| Do.....     | 120 | .0050 | 13.5 |
| Do.....     | 200 | .0030 | 8.5  |
| Copper..... | 200 | .0030 | 6.6  |

## EXAMPLE 20

| Metal Particles | Mesh No. | Approx. Particle Dia. | Percent plus or minus 2% |
|-----------------|----------|-----------------------|--------------------------|
| Nickel.....     | 100      | .005                  | 60                       |
| Do.....         | 325      | .0017                 | 40                       |

## EXAMPLE 21

|             |     |       |    |
|-------------|-----|-------|----|
| Nickel..... | 100 | .005  | 50 |
| Do.....     | 325 | .0017 | 20 |
| Copper..... | 200 | .003  | 30 |

As indicated heretofore, the water settable pattern composition of this invention, in addition to the metal particles, includes a high temperature water settable binder or cement. The water settable binder must not only possess the required thermal stability, both structural and dimensional, during the temperature cycles encountered while the pattern or the like is in use, but should on setting exhibit adequate tensile strength. Preferably, the high temperature binder is of the calcium aluminate hydraulic binder having the following recipe:

|                                      | Maximum Percent | Minimum Percent |
|--------------------------------------|-----------------|-----------------|
| SiO <sub>2</sub> .....               | 10.00           | 0.10            |
| Al <sub>2</sub> O <sub>3</sub> ..... | 80.00           | 38.00           |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 12.00           | 0.40            |
| CaO.....                             | 38.00           | 18.00           |

An example of a high temperature calcium aluminate binder useful in accordance with this invention is that calcium aluminate binder manufactured by the Lumnite Division of the Universal Atlas Cement Company and sold under the trade name "Lumnite." Another example is the calcium aluminate binder manufactured by the La Farge Aluminous Cement Company, Ltd., England, and sold under the trade name "Cement Fondu." A still further example of a suitable binder is the calcium aluminate binder manufactured by the Aluminum Company of America and sold under the trade name "Alcoa XCA-25."

The chemical analyses of the above-mentioned calcium aluminate binders are given in the following Examples 22-24.

## EXAMPLE 22

"Lumnite"

| Ingredient:                          | Percent by weight                       |
|--------------------------------------|-----------------------------------------|
| Al <sub>2</sub> O <sub>3</sub> ..... | 41 (small percent of TiO <sub>2</sub> ) |
| CaO.....                             | 37.0                                    |
| SiO <sub>2</sub> .....               | 9.4                                     |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 5.1                                     |
| Other ingredients.....               | 7.5                                     |

## EXAMPLE 23

"Cement Fondu"

| Ingredient:                          |       |
|--------------------------------------|-------|
| Al <sub>2</sub> O <sub>3</sub> ..... | 38.00 |
| CaO.....                             | 38.00 |
| SiO <sub>2</sub> .....               | 5.25  |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 12.00 |
| Other ingredients.....               | 6.75  |

## EXAMPLE 24

"Alcoa XCA-25"

| Ingredient:                          |       |
|--------------------------------------|-------|
| Al <sub>2</sub> O <sub>3</sub> ..... | 80.00 |
| CaO.....                             | 18.00 |
| SiO <sub>2</sub> .....               | 0.1   |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 0.4   |
| Other ingredients.....               | 1.5   |

It should be pointed out that cement normally used

for building purposes, such as Portland cement, is not useful as a binder in this invention, for it does not have the required thermal and structural stability to withstand the temperature cycles encountered in using the patterns and the like.

The amounts of metal powder and binder used will vary depending upon the desired characteristics of the pattern or the like to be produced. In general, the metal powder is in an amount from 2½ parts by weight to six parts by weight per part of binder. The greater the surface to be treated, the greater amount of binder that is required. Hence, wherein the metal particles are of a fine mix, a larger amount of binder will be required than where the metal particles are of a coarse mix.

In producing the water settable pattern composition, the metal powder is mixed with the binder in dry state and given a thorough mixing (dry) in a mixer, such as a muller, for a sufficient period of time, such as for twenty to thirty minutes to insure complete blending. After dry mixing, water is added and the resulting mixture is mixed in a mixer to insure complete dispersion of the particles. The amount of water will vary depending upon the area of the surface to be treated. As in the case of the binder, the finer the metal particle mix, the greater the amount of water which must be used. In general, the water is in an amount from 50 to 100% by weight of the binder.

If so desired, a small amount, such as 1%, of a wetting agent may be added to the wet mixture to reduce the water content which results in a faster setting of the pattern composition. Also, a small amount, such as 5%, of ethyl alcohol may be added to accelerate the vaporization of the water. To provide additional strength to the pattern or the like produced in accordance with this invention, reinforcements, such as rods, wire mesh, etc., can be added at the time of investment of the mix to the producing mold. However, these reinforcements must be of a metal that has similar expansion properties of the metal particles used in forming the pattern or the like.

The following Examples 25-34 are now given of water settable pattern compositions, produced in accordance with this invention.

## EXAMPLE 25

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 5..... | 100             |
| "Lumnite".....                       | 40              |

The above mixture is first mixed thoroughly in a dry state. In use, a suitable amount of water, such as 32 parts of water, is added and the resulting mixture is mixed thoroughly.

## EXAMPLE 26

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 3..... | 100             |
| "Cement Fondu".....                  | 34              |

To the above blended mixture are added 25.5 parts of water.

## EXAMPLE 27

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 1..... | 100             |
| "Alcoa-XCA-25".....                  | 29              |

To the above blended mixture are added 20.8 parts of water.

## EXAMPLE 28

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 6..... | 100             |
| "Lumnite".....                       | 25              |

To the above blended mixture are added 17.5 parts of water.

## EXAMPLE 29

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 7..... | 100             |
| "Cement Fondu".....                  | 22.5            |

To the above blended mixture are added 15.75 parts of water.

## EXAMPLE 30

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 8..... | 100             |
| "Alcoa-XCA-25" .....                 | 20              |

To the above blended mixture are added 14 parts of water.

## EXAMPLE 31

| Ingredients:                         | Parts by weight |
|--------------------------------------|-----------------|
| Metal particle mix of Example 3..... | 100             |
| "Lumnite" .....                      | 20              |

To the above blended mixture are added 12.5 parts of water.

## EXAMPLE 32

| Ingredients:                          | Parts by weight |
|---------------------------------------|-----------------|
| Metal particle mix of Example 10..... | 100             |
| "Cement Fondu" .....                  | 17              |

To the above blended mixture are added 12 parts of water.

## EXAMPLE 33

| Ingredients:                          | Parts by weight |
|---------------------------------------|-----------------|
| Metal particle mix of Example 11..... | 100             |
| "Alcoa-XCA-25" .....                  | 20              |

To the above blended mixture are added 9.5 parts of water.

## EXAMPLE 34

| Ingredients:                          | Parts by weight |
|---------------------------------------|-----------------|
| Metal particle mix of Example 20..... | 100             |
| "Lumnite" .....                       | 25              |

To the above blended mixture are added 20.3 parts of water.

In producing the novel patterns and the like of this invention, the following procedure is used. As indicated heretofore, the metal powder and binder are mixed thoroughly in dry form after which water is added to form a pasty aggregate. The pasty aggregate is inserted into a suitable pattern mold and allowed to set while subjected to vibration, thus forming the desired pattern and the like. Any suitable vibrator may be used for vibrating the aggregate, such as a Red Devil vibrator. In setting, the aggregate is preferably allowed to set at a temperature in the range of 50° to 80° F. in an atmosphere of 75 to 100% relative humidity.

The pattern mold may be made from a ceramic material, rubber or other suitable material. Of course, in forming the desired pattern mold, a detailed drawing is first made of the object to be cast and a wood pattern is made from the drawing. The wood pattern is then set in a box containing a ceramic material, such as plaster of Paris, liquid rubber or other equivalent settable material. On setting, the wood pattern is then removed, leaving the pattern imprint on the mold. From this pattern mold, the pattern is produced in a manner described hereinabove.

I have found that the surface smoothness of the finished pattern is the greatest when a rubber pattern mold is used in producing the pattern. This appears to be due to the fact that rubber is completely non-hydroscopic, so that the mix of powdered metal, binder and water remains constant.

This application is a continuation-in-part of my copending application Serial No. 231,903, filed June 15, 1951 (now abandoned).

The invention in its broader aspects is not limited to the specific steps, compositions, combinations and improvements described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

I claim:

1. A pattern of high dimensional and structural stability, good thermal conductivity and high surface smoothness consisting essentially of metallic particles se-

lected from the group consisting of iron powder, steel powder, iron alloy powder, steel alloy powder, nickel powder, copper powder and mixtures of the foregoing having a mesh size in the range of —325 mesh to 16 mesh, and a water set, high temperature calcium aluminate hydraulic binder possessing high structural and dimensional thermal stability, said metal particles being in an amount from about 2½ to about 6 parts by weight per part of calcium aluminate binder.

2. A pattern according to claim 1 wherein said calcium aluminate hydraulic binder has the following recipe:

|                                      | Maximum,<br>Percent by<br>weight | Minimum,<br>Percent by<br>weight |
|--------------------------------------|----------------------------------|----------------------------------|
| SiO <sub>2</sub> .....               | 10.00                            | 0.10                             |
| Al <sub>2</sub> O <sub>3</sub> ..... | 80.00                            | 38.00                            |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 12.00                            | 0.40                             |
| CaO.....                             | 38.00                            | 18.00                            |

3. A pattern according to claim 1 wherein the metal particles are iron powder.

4. A pattern according to claim 3 wherein the iron particles are a mixture of iron particles of different mesh size.

5. A product according to claim 4 wherein the iron particles consist of 51.0% by weight 16 mesh iron powder, 12.5% 20 mesh iron powder, 11.0% 40 mesh iron powder, 9.0% 50 mesh iron powder, 6.5% 70 mesh iron powder and 10.0% 200 mesh iron powder.

6. A product according to claim 5 wherein the calcium aluminate hydraulic binder is of the following recipe:

|                                      |       |
|--------------------------------------|-------|
| Al <sub>2</sub> O <sub>3</sub> ..... | 80.00 |
| CaO.....                             | 18.00 |
| SiO <sub>2</sub> .....               | 0.1   |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 0.4   |
| Other ingredients.....               | 1.5   |

7. A product according to claim 6 wherein the metallic particles are in an amount of 100 parts by weight and the calcium aluminate hydraulic binder is in an amount 20 parts by weight.

8. A process for the manufacture of a pattern which comprises filling the imprint of a mold with a water settable, pasty aggregate consisting essentially of water, metallic particles selected from the group consisting of iron powder, steel powder, iron alloy powder, steel alloy powder, nickel powder, copper powder and mixture of the foregoing having a mesh size in the range of —325 mesh to 16 mesh, and a water set, high temperature calcium aluminate hydraulic binder possessing high structural and dimensional thermal stability, said metal particles being in an amount from about 2½ to about 6 parts by weight per part of calcium aluminate binder, and permitting the aggregate to harden to form the desired pattern.

9. A process according to claim 8 wherein the metal particles are iron powder.

10. A process according to claim 8 wherein the iron particles are a mixture of iron particles of different mesh size.

11. A process according to claim 8 wherein the iron particles consist of 51.0% by weight 16 mesh iron powder, 12.5% 20 mesh iron powder, 11.0% 40 mesh iron powder, 9.0% 50 mesh iron powder, 6.5% 70 mesh iron powder and 10.0% 200 mesh iron powder.

12. A process according to claim 8 wherein the calcium aluminate hydraulic binder is of the following recipe:

|                                      |       |
|--------------------------------------|-------|
| Al <sub>2</sub> O <sub>3</sub> ..... | 80.00 |
| CaO.....                             | 18.00 |
| SiO <sub>2</sub> .....               | 0.1   |
| Fe <sub>2</sub> O <sub>3</sub> ..... | 0.4   |
| Other ingredients.....               | 1.5   |

13. A process according to claim 8 wherein the metallic parts are in an amount of 100 parts by weight and the calcium aluminate hydraulic binder is in an amount 20 parts by weight.

14. A pattern of high dimensional and structural stability, good thermal conductivity and high surface smoothness consisting essentially of metallic particles in the form of a powder selected from the group consisting of iron powder, steel powder, iron alloy powder, steel alloy powder, nickel powder, copper powder and mixtures of the foregoing, and a water set, high temperature calcium aluminate hydraulic binder possessing high structural and dimensional thermal stability, said metal particles being in an amount from about 2½ to about 6 parts by weight per part of calcium aluminate binder.

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