

PATENT SPECIFICATION

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(54) DRAIN CLEANING COMPOSITIONS

(71) We, BRISTOL-MYERS COMPANY, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 345 Park Avenue, New York, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to new and improved compositions which are heat producing upon contact with water and which are useful as drain cleaners.

Dry compositions which liberate heat upon contact with moisture are well-known in the drain cleaning art. U.S. Patent No. 2,773,040 discloses heat liberating compositions containing aluminum and, an alkali metal hydroxide. U.S. Patent No. 2,816,012 discloses heat producing compositions containing aluminum, an alkali metal hydroxide, a water-soluble inorganic nitrate and copper.

It has now surprisingly been found that powdered aluminum will react with alkali metal salts of acids having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} to produce excellent heat producing drain cleaners.

The present invention provides a heat producing, drain cleaning composition comprising (a) from 0.5 to 16.7% by weight of aluminum powder having a particle size of from 1 to 300 microns, (b) from 16.0 to 59.0% by weight of an alkali metal nitrate, and (c) from 15.6 to 73.2% by weight of an alkali metal salt of hydroquinone, saccharin or of an acid having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} , said composition being substantially free of alkali metal hydroxide.

The compositions of the present invention are non-toxic and do not include alkali metal hydroxide therein.

The present invention further provides a process for producing a heat producing, drain cleaning composition comprising (a) from 0.5 to 16.7% by weight of aluminum powder having a particle size of from 1 to 300 microns, (b) from 16.0 to 59.0% by weight of an alkali metal nitrate, and (c) from 15.6 to 73.2% by weight of an alkali metal salt of hydroquinone, saccharin or of an acid having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} , characterized in that ingredients (a), (b) and (c) are mixed or conglomerated by way of fusion, compacted or granulated and pelletized to a particle range of 210—4760 microns, preferably 841—2380 microns.

The present invention also provides a process for cleaning a drain clogged with organic material bound by a meltable binding material which comprises introducing a heat producing, drain cleaning composition comprising (a) from 0.5 to 16.7% by weight of aluminum powder having a particle size of from about 1 to about 300 microns, (b) from 16.0 to 59.0% by weight of an alkali metal nitrate, and (c) from 15.6 to 73.2% by weight of an alkali metal salt of hydroquinone, saccharin or of an acid having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} , said composition being substantially free of alkali metal hydroxide within the drain and into the aqueous solution adjacent the clog whereby an exothermic reaction coupled with vigorous churning results, heat of reaction sufficient to melt said binding material is generated and the clog is dissolved.

Generally, the flow of water through a drain becomes obstructed by the ac-

2 cumulation of organic material lodged in the U-bend of the drain trap. The organic materials are usually held together by a hot melted binding material such as a fat, oil, or grease, which has cooled and solidified. In order to unclog a drain, a good drain cleaner should be capable of producing sufficient heat to re-melt this binding material and dissolve the clog. Thereafter, organic materials forming the clog may be carried away with the flow of water through the drain.

5 It has been determined that the heat producing drain cleaner composition of the present invention is capable of generating sufficient heat to raise the temperature of water above the minimum temperature necessary to re-melt the binding material in the drain in order to dissolve the clog. The relative amounts of the composition ingredients may be varied depending on how much heat is desired to be generated and depending on how quickly it is desired that the drain be unclogged. However, the drain cleaning composition should be capable of generating heat sufficient to raise the temperature of water in the drain, at the point of the clog, above the minimum temperature necessary for dissolving the clog.

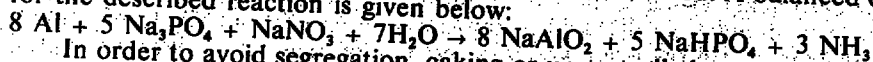
10 Examples of suitable acids having an ionization constant in water not exceeding 6.0×10^{-9} include:

	Ionization Constant
20 Salicylic Acid	1.0×10^{-13}
Alpha Aminoacetic Acid	1.67×10^{-10}
Hydroquinone	4.5×10^{-11}
Para Hydroxybenzoic Acid	4.8×10^{-10}
Saccharin	2.1×10^{-12}
25 Carbonic Acid	5.61×10^{-11}
Pyrophosphoric Acid	6×10^{-9}
Ethylenediaminetetraacetic Acid	5.5×10^{-11}
Diethylenetriaminepentaacetic Acid	3.8×10^{-11}
N-Hydroxyethylenediaminetriacetic Acid	1.86×10^{-10}
30 Nitrilotriacetic Acid	1.86×10^{-10}
Phosphoric Acid	4.8×10^{-13}

Alkali metal salts of these acids, e.g. the sodium potassium, lithium, rubidium and cesium salts, are preferred in the drain cleaning compositions of the present invention.

35 When a salt of an acid which has at least one hydrogen with an ionization constant of 6.0×10^{-9} or less reacts with aluminum powder, free hydrogen is liberated. Oxidizing agents, particularly water-soluble nitrates, have long been used in alkali metal hydroxide heat producing drain cleaners for the purpose of oxidizing the released free hydrogen to non-gaseous compounds. In the oxidation-reduction reaction between free hydrogen and the nitrate ion, molecular hydrogen with zero valence is oxidized to combined hydrogen with a valence of plus one. The nitrogen combined in the nitrate ion with a valence of plus five is reduced to ammonia, in which it has a valence of minus three, or to nitrate, in which it has a valence of plus three. The benefits are two-fold. Liberation of free hydrogen is prevented and the reaction, being exothermic, substantially increases generation of heat. Alkali metal nitrates are preferred.

45 The third hydrogen of phosphoric acid has an ionization constant in water of 4.8×10^{-13} . When properly formulated in accordance with the invention, the tri-sodium salt of this acid, which is used widely in industry and in the household and is not considered toxic or especially hazardous, can be used to make a good heat producing drain cleaner. When a salt such as tri-sodium phosphate is combined with aluminum powder and the surface area is controlled by particle size, the reaction is exothermic and can be regulated so as to pass through a slowly rising temperature time period until a vigorous turbulent hot reaction mixture is obtained. When these ingredients are combined with a water-soluble nitrate, mixed or conglomerated by way of fusion, compacted or granulated and pelletized to a limited particle range of 210—4760 microns, preferably 841—2380 microns, an excellent, non-toxic, non-hazardous drain cleaner is obtained. A balanced equation for the described reaction is given below:



60 In order to avoid segregation, caking or uncontrolled reaction rates it is important that all of the components be substantially homogeneously distributed. By preparing the compositions in accordance with the invention there is a delayed but controllable induction period of the reaction of the components with the water at the site of the drain impediment.

The rate of reaction will depend chiefly on the temperature of the water and the particle size of the aluminum. For any given particle size the rate of reaction will increase as the temperature of the water increases. It is important that the initial heat production be such as to provide (1) heat loss due to dissipation from the system and (2) sufficient heat to raise the temperature of the surrounding water and suspended aluminum so that the auto-catalytic effect of temperature will provide an increased rate of reaction resulting in a hot boiling mixture. An ideal formulation would contain aluminum particles of different size. This would provide for initial heat generation by smaller particles and then a slower extended reaction of a selected distribution of somewhat larger particles. Although such a distribution of aluminum particle size is desirable, it is not necessary to the production of a useful product. It has been found that by formulating with mixtures of aluminum powders having a particle size range of from 1 micron to 300 microns and preferably from 15 to 50 microns, a very effective heat producing drain cleaner can be produced.

From the equation given for the reaction of aluminum, tri-sodium phosphate, sodium nitrate and water, one can calculate 215.76 g. of aluminum will react with 819.86 g. of tri-sodium phosphate and 255.03 g. of sodium nitrate. This is a ratio of 8 moles of aluminum to 5 moles of tri-sodium phosphate to 3 moles of sodium nitrate. Such a composition would contain 16.7% aluminum powder. A product containing that much aluminum would provide more heat than would be desirable for the usual 30—45 g. charge added to a clogged drain. A heat producing composition, according to the invention, can be prepared with an aluminum powder content as low as 0.5%; however, for best performance with maximum safety it is preferred to use a composition containing 4.1% aluminum.

The reaction ratio of 8—5—3 requires 3 moles of sodium nitrate or 1.18 g. of sodium nitrate for each gram of aluminum powder. This is the theoretical lower limit which can be formulated without liberating free hydrogen gas. To provide for a greater margin of safety, it is preferred to use 4 to 8 g. of sodium nitrate or its equivalent as potassium nitrate for each gram of aluminum powder.

From the equation it can be seen that 5 moles of tri-sodium phosphate, or any other reacting salt, is required for each 8 moles of aluminum powder. In the case of tri-sodium phosphate, this is 3.8 g. for each gram of aluminum powder. The use of excess reacting salt is advisable in order to insure maximum heat generation and conversion to the water-soluble aluminate ion. Compositions may be prepared with as low as 10% tri-sodium phosphate. This would be a molar ratio of 0.4 moles for each mole of aluminum powder at the preferred aluminum powder concentration of 4.1%. For reasons of simplicity most of the foregoing discussion has been limited to aluminum powder, tri-sodium phosphate and sodium nitrate. Other ingredients (b) and (c) may, of course, be used in the compositions of the invention. Ingredient (c) may be, for example, sodium tripolyphosphate.

Due to the low water solubility of disodium hydrogen phosphate hydrate ($\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$), one of the products of the reaction when the ingredients are mixed in the presence of water, it is preferred to use potassium salts or to incorporate a considerable portion of potassium ion into the formulation. $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$ has a melting point of 35.1°C . and a solubility of only 4.15 g. per 100 ml. of cold water. If the reaction products are not washed out of the drain while still hot, the $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$ can crystallize out of solution. By using tri-potassium phosphate and sodium nitrate or tri-sodium phosphate and potassium nitrate, crystallization of insoluble di-sodium hydrogen phosphate hydrate is prevented even if the reaction products are not flushed from the drain before cooling.

Thus, the presence of potassium ions prevents the crystallization of insoluble $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$ which has a solubility of 4.15 grams per 100 ml. of cold water. The formulations of the present invention exceed this value by more than 300%.

The preferred compositions according to the invention include, preferably about 2%, of a non-aqueous, tacky liquid surfactant such as sulfonated mineral oil (e.g. Twitchell 8266, a trademark of Emery Industries, Inc.) or a combination of mono and diphosphate esters of ethoxylated linear alcohol (e.g. Gafac, a trademark of General Aniline & Film Corporation) or oxyethylated primary straight chain alcohols containing 12 to 20 carbon atoms and 80% ethylene oxide (e.g. Plurofac A-38, a trademark of Wyandotte Chemicals Corporation). However, any other tacky material may also be used.

In order to illustrate the invention the following examples are given:

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Example 1.

59.0 g. of potassium nitrate, 36.0 g. of tri-sodium phosphate and 5.0 g. of aluminum powder were mixed and fused at 360° C. The fused mixture was allowed to cool and was then granulated. 30.0 g. of granulated material were added to 100 ml. of water at 30° C. in a 300 ml. test tube. After five minutes the temperature of the water increased to 100° C. The temperature rise was accompanied by vigorous churning in the lower portion of the test tube. The 100° C. temperature was maintained for six minutes.

Example 2.

20.0 g. of sodium nitrate were mixed with 18.3 g. of tri-potassium phosphate and 1.7 g. of powdered aluminum. The mixture was heated over a burner until fusion of the sodium nitrate occurred. Upon cooling, a hard cake was formed. The cake was granulated to about 6—20 mesh and 30.0 g. of the granulated material were added to 100 ml. of water in a large test tube. A slow temperature rise was observed, starting at 25° C. and going up to 50° C. in a period of eight minutes. The temperature then increased rapidly to 103° C. and held there for seven minutes.

Example 3.

3.0 g. of powdered tri-sodium phosphate, 1.2 g. of aluminum powder, and 0.8 g. of potassium nitrate were fused at 380° C. After cooling, the fused mixture was granulated and added to 5.8 g. of potassium chloride, 9.8 g. of potassium nitrate and 10.0 g. of granular tri-sodium phosphate. 30.0 g. of this mixture were added to 100 ml. of water at 25° C. in a 300 ml. test tube. After two minutes, the temperature in the lower half of the test tube increased to 99° C.

Example 4.

1440 g. of tri-potassium phosphate, 60 g. Plurofac A-38 (trademark of Wyandotte Chemical Co., a non-ionic surfactant which is an oxyethylated straight chain alcohol) and 1371 g. of sodium nitrate were mixed and powdered by passing through a hammer mill. After grinding, 2400 g. of the powdered mixture were mixed with 107.5 g. of aluminum powder, 250 g. of white mineral oil, and 0.65 g. of green pigment (Phthalo green). The mix was then pelletized with a laboratory model "California Pellet Mill" using a 3/16" x 1" die. The resulting green pellets were very hard. When a 30 g. sample was added to 100 g. of water at 25° C. in a 300 ml. test tube, the temperature of the water in the lower half of the test tube increased slowly over a five-minute period to 100° C. at 100° C., the pellets disintegrated and a churning action was observed.

Example 5.

9.0 g. of potassium nitrate were mixed with 0.6 g. of "Twitchell 8266" (trademark of Emery Industries Inc., a sulphonated mineral oil surfactant). Then 1.23 g. of aluminum powder were added. Upon additional mixing, the aluminum adhered to the surface of the potassium nitrate. 7.5 g. of tri-sodium phosphate and 11.67 g. of potassium chloride were then added. The formulation was mixed and added to 100 ml. of water at 25° C. in a 300 ml. test tube. The temperature increased slowly. After 15 minutes the temperature of the water in the lower portion of the test tube had increased to 100° C. and the reaction proceeded with vigorous churning.

It can be seen from the preceding examples and the drain cleaner tests which follow that the relative proportions of the ingredients of the composition may be varied over a wide range while retaining the effectiveness of the heat generating drain cleaning composition of the instant invention.

25 g. of a clog mixture, consisting of 2% hair, 40% calcium soap curd, 20% coffee grounds, and 38% hot melted beef fat were placed at the bottom of the U-bend of a drain trap in a common household 1 1/4" metal drain. The clog mixture was constructed so as to completely obstruct the flow of water from the inlet side to the outlet side of the drain trap. Water was added to both sides of the trap until it reached the level of the exit side runoff. A 100 g. test composition was prepared for each of the formulations of Examples 6—70 of Table I. The ingredients of the test composition were mixed to obtain a homogenous mixture, which was then pressed, at a pressure of 24,000 lbs. per square inch, into ten individual 10-gram tablets. The 10-gram tablets were then broken down and granulated to about 841 to about 2380 micron size. The test sample weight of the granulated material, shown in Table I for each example, was then added to the clogged drain trap, after

which one cup of water was added to the inlet side, raising the water level in the inlet side higher than in the exit side. A thermometer was placed in the inlet side so that the thermometer bulb was at or near the location of the clog and test sample. In all examples of Table I, the solution at the location of the clog became hot. As the hot mixture melted the material binding the clog, water from the inlet side of the trap passed through the clog to the exit side. Five minutes from the time that the exit side water flow began, one liter of water was added to the inlet side. Water flow at the exit side was found to be uninhibited and for all examples given in Table I, the material originally used to make the clog was washed out of the trap leaving the drain completely unclogged and free flowing.

Table I.

	Weight of Sample Added to Clogged Drain (g.)	Time Required to Open Drain (min.)	Temp. at Clog When Drain Opened (°C.)
<u>Example No. 6</u>			
Na ₃ PO ₄	36.0		
Na NO ₃	16.0		
Aluminum Powder (2)	0.5		
Na-Gluconate	10.0		
NaCl	37.5		
	100.0 g.	75	11
			87
<u>Example No. 7</u>			
Na ₃ PO ₄	36.0		
Na NO ₃	16.0		
Aluminum Powder (2)	16.7		
NaCl	31.3		
	100.0 g.	30	7
			101
<u>Example No. 8</u>			
Na ₃ PO ₄	36.0		
Na NO ₃	59.0		
Aluminum Powder (2)	5.0		
	100.0 g.	50	8
			100
<u>Example No. 9</u>			
Na ₃ PO ₄	36.0		
Na NO ₃	59.0		
Aluminum Powder (2)	0.5		
NaCl	4.5		
	100.0 g.	75	8
			89
<u>Example No. 10</u>			
Na ₃ PO ₄	73.2		
Na NO ₃	16.0		
Aluminum Powder (2)	0.5		
NaCl	10.3		
	100.0 g.	75	9
			90
<u>Example No. 11</u>			
Na ₃ PO ₄	73.2		
Na NO ₃	16.0		
Aluminum Powder (1)	10.8		
	100.0 g.	50	9
			100

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C)
<u>Example No. 12</u>			
Na ₃ PO ₄	36.0		
Na NO ₃	47.3		
Aluminum Powder (1)	16.7		
	100.0 g. 50	12	100
<u>Example No. 13</u>			
Na ₃ PO ₄	50.0		
Na NO ₃	49.5		
Aluminum Powder (3)	0.5		
	100.0 g. 75	8	90
<u>Example No. 14</u>			
K ₃ PO ₄	36.0		
K NO ₃	16.0		
Aluminum Powder (3)	0.5		
Na-Gluconate	10.0		
KCl	37.5		
	100.0 g. 75	12	92
<u>Example No. 15</u>			
K ₃ PO ₄	36.0		
K NO ₃	16.0		
Aluminum Powder (2)	16.7		
KCl	31.3		
	100.0 g. 50	9	102
<u>Example No. 16</u>			
K ₃ PO ₄	36.0		
K NO ₃	59.0		
Aluminum Powder (3)	5.0		
	100.0 g. 50	7	96
<u>Example No. 17</u>			
K ₃ PO ₄	36.0		
K NO ₃	59.0		
Aluminum Powder (3)	0.5		
KCl	4.5		
	100.0 g. 75	8	93
<u>Example No. 18</u>			
K ₃ PO ₄	73.2		
K NO ₃	16.0		
Aluminum Powder (1)	0.5		
KCl	10.3		
	100.0 g. 50	14	100

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C)
<u>Example No. 19</u>			
K ₃ PO ₄	73.2		
KNO ₃	16.0		
Aluminum Powder (1)	10.8		
	<u>100.0 g.</u> 50	12	103
<u>Example No. 20</u>			
K ₃ PO ₄	36.0		
KNO ₃	47.3		
Aluminum Powder (3)	16.7		
	<u>100.0 g.</u> 30	8	101
<u>Example No. 21</u>			
K ₃ PO ₄	50.0		
KNO ₃	49.5		
Aluminum Powder (2)	0.5		
	<u>100.0 g.</u> 75	7	90
<u>Example No. 22</u>			
Na ₃ PO ₄	40.0		
KNO ₃	20.0		
Na-Gluconate	3.0		
Aluminum Powder (2)	4.2		
KCl	32.8		
	<u>100.0 g.</u> 30	7	102
<u>Example No. 23</u>			
Na ₂ CO ₃	36.0		
NaNO ₃	16.0		
Aluminum Powder (3)	0.5		
Na-Gluconate	10.0		
NaCl	37.5		
	<u>100.0 g.</u> 75	16	77
<u>Example No. 24.</u>			
Na ₂ CO ₃	36.0		
NaNO ₃	16.0		
Aluminum Powder (3)	16.7		
NaCl	31.3		
	<u>100.0 g.</u> 50	19	100
<u>Example No. 25</u>			
Na ₂ CO ₃	36.0		
NaNO ₃	59.0		
Aluminum Powder (3)	5.0		
	<u>100.0 g.</u> 50	19	103

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C)
<u>Example No. 26.</u>			
Na ₂ CO ₃	36.0		
Na NO ₃	59.0		
Aluminum Powder (3)	0.5		
NaCl	4.5		
	<u>100.0 g.</u>	75	18
			89
<u>Example No. 27</u>			
Na ₂ CO ₃	73.2		
Na NO ₃	16.0		
Aluminum Powder (2)	0.5		
NaCl	10.3		
	<u>100.0 g.</u>	75	16
			100
<u>Example No. 28</u>			
Na ₂ CO ₃	73.2		
Na NO ₃	16.0		
Aluminum Powder (1)	10.8		
	<u>100.0 g.</u>	50	10
			102
<u>Example No. 29</u>			
Na ₂ CO ₃	36.0		
Na NO ₃	47.3		
Aluminum Powder (3)	16.7		
	<u>100.0 g.</u>	75	15
			103
<u>Example No. 30</u>			
Na ₂ CO ₃	50.0		
Na NO ₃	49.5		
Aluminum Powder (3)	0.5		
	<u>100.0 g.</u>	75	19
			75
<u>Example No. 31</u>			
K ₂ CO ₃	36.0		
K NO ₃	16.0		
Aluminum Powder (3)	0.5		
Na-Gluconate	10.0		
KCl	37.5		
	<u>100.0 g.</u>	75	16
			89
<u>Example No. 32</u>			
K ₂ CO ₃	36.0		
K NO ₃	16.0		
Aluminum Powder (2)	16.7		
KCl	31.3		
	<u>100.0 g.</u>	50	9
			104

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C)
<u>Example No. 33</u>			
K ₂ CO ₃	36.0		
KNO ₃	59.0		
Aluminum Powder (2)	5.0		
	<u>100.0 g.</u>	75	12
			101
<u>Example No. 34</u>			
K ₂ CO ₃	36.0		
KNO ₃	59.0		
Aluminum Powder (3)	0.5		
KCl	4.5		
	<u>100.0 g.</u>	75	18
			92
<u>Example No. 35</u>			
K ₂ CO ₃	73.2		
KNO ₃	16.0		
Aluminum Powder (2)	0.5		
KCl	10.3		
	<u>100.0 g.</u>	75	9
			87
<u>Example No. 36</u>			
K ₂ CO ₃	73.2		
KNO ₃	16.0		
Aluminum Powder (1)	10.8		
	<u>100.0 g.</u>	50	8
			104
<u>Example No. 37</u>			
K ₂ CO ₃	36.0		
KNO ₃	47.3		
Aluminum Powder (2)	16.7		
	<u>100.0 g.</u>	50	9
			102
<u>Example No. 38</u>			
K ₂ CO ₃	50.0		
KNO ₃	49.5		
Aluminum Powder (3)	0.5		
	<u>100.0 g.</u>	75	13
			89
<u>Example No. 39</u>			
Na ₂ CO ₃	50.0		
KNO ₃	25.0		
Aluminum Powder (2)	4.2		
Na-Gluconate	5.0		
KCl	15.8		
	<u>100.0 g.</u>	30	7
			102

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C.)
Example No. 40			
Na ₃ PO ₄	10.0		
K ₃ PO ₄	10.0		
Na ₂ CO ₃	10.0		
K ₂ CO ₃	10.0		
KNO ₃	10.0		
NaNO ₃	10.0		
Aluminum Powder (2)	4.2		
Na-Gluconate	7.0		
NaCl	14.4		
KCl	14.4		
	100.0 g. 50	7	103
Example No. 41			
Na ₄ P ₂ O ₇	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.3		
	100.0 g. 75	25	101
Example No. 42			
K ₄ P ₂ O ₇	73.2		
NaNO ₃	16.0		
Aluminum Powder (2)	0.5		
NaCl	10.3		
	100.0 g. 75	11	90
Example No. 43			
Na ₄ P ₂ O ₇	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
Na-Gluconate (2)	7.0		
KCl	8.8		
	100.0 g. 50	15	101
Example No. 44			
Ethylenediaminetetra- acetic Acid (Tetra- Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.3		
	100.0 g. 75	18	100
Example No. 45			
Ethylenediaminetetra- acetic Acid (Tetra- Sodium Salt)	73.2		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g. 50	11	86

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C)
<u>Example No. 46</u>			
Ethylenediaminetetra- acetic Acid (Tetra- Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	<u>100.0 g.</u> 50	9	100
<u>Example No. 47</u>			
Nitrilotriacetic Acid (Tri-Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.3		
	<u>100.0 g.</u> 75	15	82
<u>Example No. 48</u>			
Nitrilotriacetic Acid (Tri-Sodium Salt)	73.2		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	<u>100.0 g.</u> 50	9	101
<u>Example No. 49</u>			
Nitrilotriacetic Acid (Tri-Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	<u>100.0 g.</u> 50	12	102
<u>Example No. 50</u>			
N-Hydroxyethylenedi- aminetriacetic Acid (Tri-Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.3		
	<u>100.0 g.</u> 50	10	99
<u>Example No. 51</u>			
N-Hydroxyethylenedi- aminetriacetic Acid (Tri-Sodium Salt)	73.2		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	<u>100.0 g.</u> 75	13	87

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C.)
<u>Example No. 52</u>			
N-Hydroxyethylenedi- aminetriacetic Acid (Tri-Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	50	15
			102
<u>Example No. 53</u>			
Diethylenetriamine- pentaacetic Acid (Penta-Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.3		
	100.0 g.	50	9
			101
<u>Example No. 54</u>			
Diethylenetriamine- pentaacetic Acid (Penta-Sodium Salt)	73.2		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g.	75	15
			102
<u>Example No. 55</u>			
Diethylenetriamine- pentaacetic Acid (Penta-Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	50	14
			103
<u>Example No. 56</u>			
Saccharin (Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.3		
	100.0 g.	50	10
			89
<u>Example No. 57</u>			
Saccharin (Sodium Salt)	73.2		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g.	75	15
			90

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C.)
<u>Example No. 58</u>			
Saccharin (Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	50	17
			102
<u>Example No. 59</u>			
Para Hydroxybenzoic Acid (Di-Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.7		
	100.0 g.	50	16
			99
<u>Example No. 60</u>			
Para Hydroxybenzoic Acid (Di-Sodium Salt)	73.0		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g.	75	14
			84
<u>Example No. 61</u>			
Para Hydroxybenzoic Acid (Di-Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	50	12
			103
<u>Example No. 62</u>			
Hydroquinone (Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.7		
	100.0 g.	50	8
			100.
<u>Example No. 63</u>			
Hydroquinone (Sodium Salt)	73.0		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g.	75	11
			92

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C.)
Example No. 64			
Hydroquinone (Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	30	8
			103
Example No. 65			
Alpha Aminoacetic Acid (Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (2)	16.7		
KCl	31.7		
	100.0 g.	50	9
			101
Example No. 66			
Alpha Aminoacetic Acid (Sodium Salt)	73.0		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g.	75	10
			99
Example No. 67			
Alpha Aminoacetic Acid (Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	30	9
			104
Example No. 68			
Salicylic Acid (Di-Sodium Salt)	36.0		
KNO ₃	16.0		
Aluminum Powder (3)	16.7		
KCl	31.7		
	100.0 g.	50	8
			103
Example No. 69			
Salicylic Acid (Di-Sodium Salt)	73.0		
NaNO ₃	16.0		
Aluminum Powder (1)	0.5		
NaCl	10.3		
	100.0 g.	75	10
			92

Table I. (Continued)

	Weight of Sample Added to Clogged Drain (g.)	Time Required To Open Drain (min.)	Temp. at Clog When Drain Opened (°C.)
<u>Example No. 70</u>			
Salicylic Acid (Di-Sodium Salt)	50.0		
KNO ₃	30.0		
Aluminum Powder (2)	4.2		
KCl	15.8		
	100.0 g.	30	8
			104

It should be noted that in Table I and in Examples 71—92

- (1) means Aluminum Powder of 250 to 297 micron particle size;
 (2) means Aluminum Powder of 10 to 20 micron particle size; and
 (3) means Aluminum Powder of 1 to 8 micron particle size.

Sodium or potassium chloride and sodium gluconate were used in some compositions of the above-listed examples, as fillers and as binders, to aid in preventing segregation of ingredients in order to maintain a homogeneous distribution of ingredients in the composition.

As can be seen from the examples in Table I, the heat producing compositions of this invention are effective in dissolving a clog and subsequently cleaning a drain in a relatively short period of time. It can also be seen from the above examples that the relative proportions of ingredients in the heat producing compositions, the weight of the sample of the composition added to the clogged drain, the time required to open the clogged drain, and the temperature at the clog when the drain was opened, vary for the different examples. Notwithstanding, in each case the test composition proved to be effective in opening the clogged drain.

The following examples are offered to further illustrate the heat producing drain cleaner compositions of the present invention. It should be noted that all amounts given are by weight.

Examples.

Example No. 71

Na ₄ P ₂ O ₇	36.0
KNO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	100.0

Example No. 73

Ethylenediamine- tetraacetic Acid (Tetra-Sodium Salt)	36.0
KNO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	100.0

Example No. 72

K ₄ P ₂ O ₇	36.0
KNO ₃	59.0
Aluminum Powder (2)	0.5
KCl	4.5
	100.0

Example No. 74

Ethylenediamine- tetraacetic Acid (Tetra-Sodium Salt)	36.0
KNO ₃	59.0
Aluminum Powder (2)	0.5
KCl	4.5
	100.0

Example (Continued).

Example No. 75

Nitrilotriacetic Acid (Tri-Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

Example No. 77

Nitrilotriacetic Acid (Tri-Sodium Salt)	36.0
NaNO ₃	16.0
Aluminum Powder (1)	16.7
NaCl	31.3
	<u>100.0</u>

Example No. 79

N-Hydroxyethylene-diaminetriacetic Acid (Tri-Sodium Salt)	36.0
Na NO ₃	59.0
Aluminum Powder (2)	0.5
NaCl	4.5
	<u>100.0</u>

Example No. 81

Diethylenetriamine-pentaacetic Acid (Penta-Sodium Salt)	36.0
K NO ₃	59.0
Aluminum Powder (2)	0.5
NaCl	4.5
	<u>100.0</u>

Example No. 83

Saccharin (Sodium Salt)	73.0
Na NO ₃	16.0
Aluminum Powder (2)	0.5
KCl	10.5
	<u>100.0</u>

Example No. 85

Para Hydroxybenzoic Acid (Di-Sodium Salt)	36.0
Na NO ₃	16.0
Aluminum Powder (3)	0.5
NaCl	47.5
	<u>100.0</u>

Example No. 76

Nitrilotriacetic Acid (Tri-Sodium Salt)	36.0
Na NO ₃	59.0
Aluminum Powder (2)	0.5
KCl	4.5
	<u>100.0</u>

Example No. 78

N-Hydroxyethylene-diaminetriacetic Acid (Tri-Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

Example No. 80

Diethylenetriamine-pentaacetic Acid (Penta-Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

Example No. 82

Saccharin (Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

Example No. 84

Saccharin (Sodium Salt)	36.0
K NO ₃	59.0
Aluminum Powder (1)	0.5
KCl	4.5
	<u>100.0</u>

Example No. 86

Para Hydroxybenzoic Acid (Di-Sodium Salt)	36.0
Na NO ₃	59.0
Aluminum Powder (2)	0.5
NaCl	4.5
	<u>100.0</u>

Examples (Continued)

Example No. 87

Para Hydroxybenzoic Acid (Di-Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (1)	16.7
KCl	31.3
	<u>100.0</u>

Example No. 89

Hydroquinone (Sodium Salt)	36.0
Na NO ₃	59.0
Aluminum Powder (2)	0.5
NaCl	4.5
	<u>100.0</u>

Example No. 91

Alpha Aminoacetic Acid (Sodium Salt)	36.0
K NO ₃	59.0
Aluminum Powder (1)	0.5
KCl	4.5
	<u>100.0</u>

Example No. 93

Salicylic Acid (Di-Sodium Salt)	36.0
K NO ₃	59.0
Aluminum Powder (1)	0.5
KCl	4.5
	<u>100.0</u>

Example No. 88

Hydroquinone (Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

Example No. 90

Alpha Aminoacetic Acid (Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

Example No. 92

Salicylic Acid (Di-Sodium Salt)	36.0
K NO ₃	16.0
Aluminum Powder (3)	0.5
KCl	47.5
	<u>100.0</u>

A unique feature of the compositions of the invention is the prevention of the precipitation of Al(OH)₃ in any appreciable amount. It would not be expected that the reaction product Na₂HPO₄ would be a strong enough base to convert most of the insoluble Al(OH)₃ to the more soluble sodium aluminate.

The reaction rate may be slowed by controlling the particle size of the ingredients and is readily varied by changing the bulk density, granulation and relative proportions of ingredients. The reaction rate may also be controlled by fusing the dry mixture and then granulating.

Figure 1, of the drawings appended hereto, shows the effect of particle size and temperature when 30 grams of a composition according to the instant invention are added to 100 ml. of water. The composition and particle size range for the samples shown in Figure 1 are as follows:

Composition (Fused-Granulated and Screened)

Aluminum Powder	4.1
Tri-sodium Phosphate	25.0
Potassium Nitrate	35.0
Potassium Chloride	35.9

Particle Size (microns)

Sample A — 4760 to 6100
Sample B — 2380 to less than 4760
Sample C — 841 to less than 2380
Sample D — less than 841

A similar plot of the effect of composition is given in Figure 2 of the appended drawings. The composition of each sample for Figure 2 is given below.

Each formulation was fused, granulated and screened to a particle size range of from 841 to 2380 microns.

Composition	Sample E (weight %)	Sample F (weight %)	Sample G (weight %)
Aluminum Powder	4.1	4.1	4.1
Tri-sodium Phosphate (Powdered)	25.0	15.6	73.2
Potassium Nitrate	35.0	22.7	22.7
Potassium Chloride	35.9	57.6	0.0
	100.0%	100.0%	100.0%

The effect of bulk density can be seen from Figure 3, of the appended drawings. Bulk density was varied by using powdered tri-sodium phosphate and granular tri-sodium phosphate. Samples were fused, granulated and screened to a particle size range of from 841 to 2380 microns.

Composition	Sample C (weight %)	Sample E (weight %)
Aluminum Powder	4.1	4.1
Tri-sodium Phosphate	25.0 (Granular)	25.0 (Powdered)
Potassium Nitrate	35.0	35.0
Potassium Chloride	35.9	35.9
	100.0%	100.0%
Bulk Density	1.05	0.85

The results presented in Figures 1, 2, and 3 show the effect of composition, particle size, and bulk density on the delayed action of the product.

WHAT WE CLAIM IS:—

1. A heat producing, drain cleaning composition comprising (a) from 0.5 to 16.7% by weight of aluminum powder having a particle size of from 1 to 300 microns, (b) from 16.0 to 59.0% by weight of an alkali metal nitrate, and (c) from 15.6 to 73.2% by weight of an alkali metal salt of hydroquinone, saccharin or of an acid having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} , said composition being substantially free of alkali metal hydroxide.

2. A composition as claimed in claim 1 wherein the acid is salicylic acid, α -aminoacetic acid, p-hydroxybenzoic acid, carbonic acid, pyrophosphoric acid, ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, N-hydroxyethylenediaminetriacetic acid, nitrilotriacetic acid or phosphoric acid.

3. A composition as claimed in claim 1 or claim 2 wherein the amounts of aluminum and of alkali metal salt (c) are such that upon contact of said composition with water, the initial amount of heat produced will provide (1) the heat loss due to dissipation from the system and (2) sufficient heat to raise the temperature of the surrounding water and suspended aluminium so that the autocatalytic effect of the temperature will provide an increased rate of reaction resulting in a hot boiling mixture.

4. A composition as claimed in any one of claims 1 to 3 wherein ingredients (a), (b) and (c) of the composition are mixed or conglomerated by way of fusion, compacted or granulated and pelletized to a particle size in the range of from 210 to 4760 microns.

5. A composition as claimed in claim 4 wherein the particle size is in the range of from 841 to 2380 microns.

6. A composition as claimed in any one of the preceding claims wherein the alkali metal nitrate is sodium nitrate or potassium nitrate.

7. A composition as claimed in any one of the preceding claims wherein the alkali metal salt (c) is tri-sodium phosphate, tri-potassium phosphate, tetrasodium pyrophosphate, tetrapotassium pyrophosphate, sodium tripolyphosphate or disodium carbonate.

8. A composition as claimed in any one of the preceding claims which

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Each formulation was fused, granulated and screened to a particle size range of from 841 to 2380 microns.

Composition	Sample E (weight %)	Sample F (weight %)	Sample G (weight %)
Aluminum Powder	4.1	4.1	4.1
Tri-sodium Phosphate (Powdered)	25.0	15.6	73.2
Potassium Nitrate	35.0	22.7	22.7
Potassium Chloride	35.9	57.6	0.0
	100.0%	100.0%	100.0%

The effect of bulk density can be seen from Figure 3, of the appended drawings. Bulk density was varied by using powdered tri-sodium phosphate and granular tri-sodium phosphate. Samples were fused, granulated and screened to a particle size range of from 841 to 2380 microns.

Composition	Sample C (weight %)	Sample E (weight %)
Aluminum Powder	4.1	4.1
Tri-sodium Phosphate	25.0 (Granular)	25.0 (Powdered)
Potassium Nitrate	35.0	35.0
Potassium Chloride	35.9	35.9
	100.0%	100.0%
Bulk Density	1.05	0.85

The results presented in Figures 1, 2, and 3 show the effect of composition, particle size, and bulk density on the delayed action of the product.

WHAT WE CLAIM IS:—

1. A heat producing, drain cleaning composition comprising (a) from 0.5 to 16.7% by weight of aluminum powder having a particle size of from 1 to 300 microns, (b) from 16.0 to 59.0% by weight of an alkali metal nitrate, and (c) from 15.6 to 73.2% by weight of an alkali metal salt of hydroquinone, saccharin or of an acid having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} , said composition being substantially free of alkali metal hydroxide.
2. A composition as claimed in claim 1 wherein the acid is salicylic acid, α -aminoacetic acid, p-hydroxybenzoic acid, carbonic acid, pyrophosphoric acid, ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, N-hydroxy-ethylenediaminetriacetic acid, nitrilotriacetic acid or phosphoric acid.
3. A composition as claimed in claim 1 or claim 2 wherein the amounts of aluminum and of alkali metal salt (c) are such that upon contact of said composition with water, the initial amount of heat produced will provide (1) the heat loss due to dissipation from the system and (2) sufficient heat to raise the temperature of the surrounding water and suspended aluminium so that the autocatalytic effect of the temperature will provide an increased rate of reaction resulting in a hot boiling mixture.
4. A composition as claimed in any one of claims 1 to 3 wherein ingredients (a), (b) and (c) of the composition are mixed or conglomerated by way of fusion, compacted or granulated and pelletized to a particle size in the range of from 210 to 4760 microns.
5. A composition as claimed in claim 4 wherein the particle size is in the range of from 841 to 2380 microns.
6. A composition as claimed in any one of the preceding claims wherein the alkali metal nitrate is sodium nitrate or potassium nitrate.
7. A composition as claimed in any one of the preceding claims wherein the alkali metal salt (c) is tri-sodium phosphate, tri-potassium phosphate, tetrasodium pyrophosphate, tetrapotassium pyrophosphate, sodium tripolyphosphate or disodium carbonate.
8. A composition as claimed in any one of the preceding claims which



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includes a surfactant which is a sulfonated mineral oil, a combination of mono and diphosphate esters of an ethoxylated linear alcohol or an oxyethylated primary straight chain alcohol containing from 12 to 20 carbon atoms and 80% ethylene oxide.

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9. A composition as claimed in claim 8 wherein said surfactant is present in an amount of about 2% by weight.

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10. A composition as claimed in any one of the preceding claims which includes potassium chloride.

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11. A composition as claimed in any one of the preceding claims wherein the aluminum powder has a particle size in the range of from 15 to 50 microns.

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12. A composition as claimed in any one of the preceding claims wherein the aluminum powder is present in an amount of about 4.1% by weight.

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13. A composition as claimed in any one of the preceding claims wherein the ingredients are present in an amount such that the mole ratio of the aluminum powder to the salt of the acid to the alkali metal nitrate is 8:5:3.

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14. A process for producing a heat producing, drain cleaning composition as claimed in claim 1 which process is characterized in that ingredients (a), (b) and (c) are mixed or conglomerated by way of fusion, compacted or granulated and pelletized to a particle range of 210 to 4760 microns, preferably 841 to 2380 microns.

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15. A composition as claimed in claim 1 substantially as hereinbefore described with reference to any one of the foregoing Examples.

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16. A process for cleaning a drain clogged with organic material bound by a meltable binding material which comprises introducing a heat producing drain cleaning composition comprising (a) from 0.5 to 16.7% by weight of aluminum powder having a particle size of from 1 to 300 microns, (b) from 16.0 to 59.0% by weight of an alkali metal nitrate, and (c) from 15.6 to 73.2% by weight of an alkali metal salt of hydroquinone, saccharin or of an acid having at least one hydrogen atom with an ionization constant in water not exceeding 6.0×10^{-9} , said composition being substantially free of alkali metal hydroxide, within the drain and into the aqueous solution adjacent the clog whereby an exothermic reaction coupled with vigorous churning results, heat of reaction sufficient to melt said binding material is generated and the clog is dissolved.

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17. A process for cleaning a drain substantially as hereinbefore described in any one of Examples 6 to 70.

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BOULT, WADE & TENNANT,
Chartered Patent Agents,
34 Cursitor Street,
London EC4A 1PO.

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