



(86) Date de dépôt PCT/PCT Filing Date: 2014/02/06
(87) Date publication PCT/PCT Publication Date: 2014/08/14
(45) Date de délivrance/Issue Date: 2021/12/14
(85) Entrée phase nationale/National Entry: 2016/08/08
(86) N° demande PCT/PCT Application No.: CA 2014/050082
(87) N° publication PCT/PCT Publication No.: 2014/121398
(30) Priorité/Priority: 2013/02/06 (US61/761,615)

(51) Cl.Int./Int.Cl. *C09K 21/04* (2006.01),
C23F 11/02 (2006.01), *C23F 11/08* (2006.01)
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(54) Titre : COMPOSITIONS IGNIFUGEANTES A BASE DE POLYPHOSPHATE D'AMMONIUM
(54) Title: AMMONIUM POLYPHOSPHATE BASED FIRE-RETARDANT COMPOSITIONS

(57) Abrégé/Abstract:

An ammonium polyphosphate based fire-retardant composition comprises an ammonium polyphosphate, a suspending agent, and an effective amount of at least two corrosion inhibiting agents selected from the group of corrosion inhibiting agents including activated carbon, Epsom salts, Gypsum, azoles, and vapour phase inhibitors. The composition may further include a xanthan gum, a coloring agent or both.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(10) International Publication Number
WO 2014/121398 A1

(43) International Publication Date
14 August 2014 (14.08.2014)

(51) International Patent Classification:

C09K 21/04 (2006.01) *C23F 11/08* (2006.01)
C23F 11/02 (2006.01)

(21) International Application Number:

PCT/CA2014/050082

(22) International Filing Date:

6 February 2014 (06.02.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/761,615 6 February 2013 (06.02.2013) US

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a
patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the
earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))

(54) Title: AMMONIUM POLYPHOSPHATE BASED FIRE-RETARDANT COMPOSITIONS

Component	Formulation in Weight %					
	Formulation 1	Formulation 2	Formulation 3	Formulation 4	Formulation 5	Formulation 6
Ammonium Polyphosphate	91.80	91.80	91.75	90.80	91.80	91.75
Attapulgite Clay	1.50	1.50	1.50	1.50	1.50	1.50
Iron Oxide	1.20	1.20	1.20	1.20	1.20	1.20
Xanthan Gum	1.30	1.30	1.30	1.30	1.30	1.30
Epsom Salt	0.10	0.10	0.15	0.10	0.10	0.15
2-mercaptobenzothiazole	0.10	0.10	0.10	0.10	0.10	0.10
Benzotriazole	1.00	2.50	2.50	2.00	2.00	2.00
VpCl-609™	2.00	1.50	1.50	2.00	-	-
Ammonium Benzoate	-	-	-	-	2.00	2.00
Ethanolamine	-	-	-	1.00	-	-
Activated Carbon	1.00	-	-	-	-	-
Total	100.00	100.00	100.00	100.00	100.00	100.00

TABLE 1

(57) Abstract: An ammonium polyphosphate based fire-retardant composition comprises an ammonium polyphosphate, a suspending agent, and an effective amount of at least two corrosion inhibiting agents selected from the group of corrosion inhibiting agents including activated carbon, Epsom salts, Gypsum, azoles, and vapour phase inhibitors. The composition may further include a xanthan gum, a coloring agent or both.

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AMMONIUM POLYPHOSPHATE BASED FIRE-RETARDANT COMPOSITIONS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of provisional application 61/761,615 filed in the United States Patent and Trademark Office on February 6, 2013.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to fire-retardant compositions and, in particular, to improved ammonium polyphosphate based fire-retardant compositions.

Description of the Related Art

[0003] It is known to use ammonium polyphosphate based fire-retardant compositions to combat wildland fires. However, ammonium polyphosphate is corrosive and may damage equipment used to produce, store, handle and apply the fire-retardant composition. There is accordingly a need for corrosion inhibiting agents which reduce the corrosivity of ammonium polyphosphate based fire-retardant compositions. Ammonium polyphosphate based fire-retardant compositions may also include a thickening agent, a coloring agent and a suspending agent that carries the coloring agent.

[0004] United States Patent Number 6,802,994 which issued on September 12, 2004 to Kegeler et al., discloses corrosion inhibited fire-retardant compositions. The corrosion inhibited fire retardant compositions are comprised of an ammonium polyphosphate, a suspending agent, and a corrosion inhibiting system. The corrosion inhibiting system is comprised of at least one corrosion inhibiting agent selected from a group of corrosion

inhibiting agents including azoles, insoluble ferric pyrophosphate, soluble ferric pyrophosphate, ferrous oxalate, ferric citrate, ferrous sulfate, ferric ammonium citrate, insoluble ferric orthophosphate, soluble ferric orthophosphate, ferric ammonium oxalate, ferric ammonium sulfate, ferric bromide, ferric sodium oxalate, ferric stearate, ferric sulfate, ferrous acetate, ferrous ammonium sulfate, ferrous bromide, ferrous gluconate, ferrous iodide, ferric acetate, ferric fluoroborate, ferric hydroxide, ferric oleate, ferrous fumarate, ferrous oxide, ferric lactate, ferric resinate and any combination thereof. The corrosion inhibiting system is typically present in the fire retardant composition of the invention in a minor amount effective to substantially reduce corrosiveness of the concentrated fire retardant composition and of its diluted solution.

[0005] United States Patent Number 6,905,639 which issued on June 14, 2005 to Vandersall et al., discloses corrosion-inhibited fire-retardant compositions. The corrosion-inhibited fire-retardant compositions are comprised of an ammonium polyphosphate, at least one biopolymer having a particle size diameter of less than about 100 microns, and a corrosion inhibiting system. The corrosion inhibiting system is comprised of at least one corrosion inhibiting agent selected from a group of corrosion inhibiting agents including azoles, insoluble ferric pyrophosphate, soluble ferric pyrophosphate, ferrous oxalate, ferric citrate, ferrous sulfate, ferric ammonium citrate, soluble ferric orthophosphate, insoluble ferric orthophosphate, ferric ammonium oxalate, ferric ammonium sulfate, ferric bromide, ferric sodium oxalate, ferric stearate, ferric sulfate, ferrous acetate, ferrous ammonium sulfate, ferrous bromide, ferrous gluconate, ferrous iodide, ferric acetate, ferric fluoroborate, ferric hydroxide, ferric oleate, ferrous fumarate, ferrous oxide, ferric lactate, ferric resinate and any combination thereof. In a specific embodiment, the corrosion-inhibited fire retardant composition includes a xanthan biopolymer.

[0006] United States Patent Number 8,202,449 which issued on June 19, 2012 to Garner et al., discloses a fire-retardant composition comprising an ammonium polyphosphate, a suspending agent and a corrosion inhibiting agent. When in solution the corrosion inhibiting agent includes at least one ion selected from the group of ions

consisting of aluminum ions, ferric ions, calcium ions and magnesium ions. Said ions complex an effective amount of fluoride ions present in the fire-retardant composition to reduce the corrosiveness of the fire-retardant composition.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide an improved ammonium polyphosphate based fire-retardant composition.

[0008] There is accordingly provided an ammonium polyphosphate based fire-retardant composition comprising an ammonium polyphosphate, a suspending agent, and an effective amount of at least one corrosion inhibiting agent. The corrosion inhibiting agent may be selected from the group of corrosion inhibiting agents consisting of ammonium benzoate, activated carbon, Epsom salts including Mg^{2+} , Gypsum including Ca^{2+} , azoles and vapour phase inhibitors. The corrosion inhibiting agents may be ammonium benzoate, benzotriazole, and 2- mercaptobenzothiazole. The fire-retardant composition may further include a xanthan gum, a coloring agent or any combination thereof. The fire-retardant composition may still further include a surfactant.

[0009] The azoles may be selected from the group of azoles including 2-mercaptobenzothiazole, dimercaptobenzothiazole and benzotriazole. The vapour phase inhibitors may be selected from the group of vapour phase inhibitors including ammonium carboxylate compounds and ethoxylated linear alcohols. The xanthan gum may have a weight average particle diameter greater than 100 microns. The suspending agent may be a sheared clay.

[0010] There is also provided an ammonium polyphosphate based fire-retardant composition comprising an ammonium polyphosphate, a suspending agent and a carbon compound which is a corrosion inhibiting agent. The carbon compound may be activated carbon.

[0011] There is also provided, an ammonium polyphosphate based fire-retardant composition comprising: an ammonium polyphosphate; a suspending agent; at least two corrosion inhibiting agents, wherein the corrosion inhibiting agents are ammonium benzoate and at least one corrosion inhibiting agent selected from the group consisting of activated carbon, azoles and vapour phase inhibitors; and a xanthan gum having a weight average particle diameter greater than 100 microns.

[0012] There is also provided, an ammonium polyphosphate based fire-retardant composition comprising: an ammonium polyphosphate; a sheared clay; a coloring agent; at least two corrosion inhibiting agents, wherein the corrosion inhibiting agents are ammonium benzoate and at least one corrosion inhibiting agent selected from the group consisting of activated carbon, 2-mercaptobenzothiazole, benzotriazole, ammonium carboxylate compounds and ethoxylated linear alcohols; and a xanthan gum having a weight average particle diameter greater than 100 microns.

[0013] There is also provided, an ammonium polyphosphate based fire-retardant composition comprising: an ammonium polyphosphate; a suspending agent; and at least three corrosion inhibiting agents, wherein the corrosion inhibiting agents are benzotriazole, ammonium benzoate and at least one corrosion inhibiting agent selected from the group consisting of activated carbon, azoles, and vapour phase inhibitors; and a xanthan gum having a weight average particle diameter greater than 100 microns.

[0014] The ammonium polyphosphate based fire-retardant composition disclosed herein provides the advantage of having reduced corrosivity.

BRIEF DESCRIPTIONS OF TABLES

[0015] The invention will be more readily understood from the following description of the embodiments thereof given, by way of example only, with reference to the accompanying tables, in which:

[0016] Table 1 shows formulations of fire-retardant compositions; and

TABLE 1

Component	Formulation in Weight %					
	Formulati on 1	Formulati on 2	Formulati on 3	Formulati on 4	Formulati on 5	Formulati on 6
Ammonium Polyphosphate	91.80	91.80	91.75	90.80	91.80	91.75
Attapulgit Clay	1.50	1.50	1.50	1.50	1.50	1.50
Iron Oxide	1.20	1.20	1.20	1.20	1.20	1.20
Xanthan Gum	1.30	1.30	1.30	1.30	1.30	1.30
Epsom Salt	0.10	0.10	0.15	0.10	0.10	0.15
2-mercaptobenzothiazole	0.10	0.10	0.10	0.10	0.10	0.10
Benzotriazole	1.00	2.50	2.50	2.00	2.00	2.00
VpCI-609™	2.00	1.50	1.50	2.00	-	-
Ammonium Benzoate	-	-	-	-	2.00	2.00
Ethanolamine	-	-	-	1.00	-	-
Activated Carbon	1.00		-	-	-	-
Total	100.00	100.00	100.00	100.00	100.00	100.00

[0017] Table 2 shows yearly corrosion rates (in mils-per-year) for the formulations of Table 1.

TABLE 2

Formulation	Aluminum Corrosion Rate in mils per year (mpy)							
	Trial 1 ¹	Trial 2 ²	Trial 3 ³	Trial 4 ⁴	Trial 5 ⁵	Trial 6 ⁶	Trial 7 ⁷	Trial 8 ⁸
Formulation 1	1.4	1.4	2.4	0.8	1.1	2.0	0.3	0.8
Formulation 2	4.6	3.0	3.3	4.2	0.2	1.1	0.0	0.9
Formulation 3	4.9	2.9	1.2	1.1	0.2	1.4	0.7	0.8
Formulation 4	4.4	2.5	0.8	1.2	0.2	1.3	0.8	0.9
Formulation 5	4.1	0.7	3.0	1.1	0.9	1.9	0.5	0.7
Formulation 6	3.9	0.6	2.4	1.1	0.7	1.2	0.5	0.9

¹ Trial 1 – Aluminum coupon in concentrated formulation at 21° Celsius with total immersion

² Trial 2 – Aluminum coupon in concentrated formulation at 21° Celsius with partial immersion

³ Trial 3 – Aluminum coupon in concentrated formulation at 49° Celsius with total immersion

⁴ Trial 4 – Aluminum coupon in concentrated formulation at 49° Celsius with partial immersion

⁵ Trial 5 – Aluminum coupon in diluted formulation at 21° Celsius with total immersion

⁶ Trial 6 – Aluminum coupon in diluted formulation at 21° Celsius with partial immersion

⁷ Trial 7 – Aluminum coupon in diluted formulation at 49° Celsius with total immersion

⁸ Trial 8 – Aluminum coupon in diluted formulation at 49° Celsius with partial immersion

DESCRIPTIONS OF THE PREFERRED EMBODIMENTS

[0018] Disclosed are novel and improved fire-retardant compositions comprising an ammonium polyphosphate; a suspending agent which may be in the form of a sheared clay such as attapulgite clay or hydrous magnesium aluminum silicate such as MINI-U-GEL® FG or MINI-U-GEL® 400 from Active Minerals International, LLC of 1130 Dade Street, Quincy, Florida 32351; an iron oxide coloring agent in the form of Bayferrox® Red 101 from Lanxess Deutschland GmbH of D-51369 Leverkusen, Federal Republic of Germany; and a xanthan gum which may have a weight average particle size diameter greater than 100 micrometers.

[0019] The fire-retardant composition further includes corrosion inhibiting agents selected from the group of corrosion inhibiting agents consisting of a magnesium containing compound such as $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (Epsom salt), with or without a calcium containing compound such as $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (Gypsum) or $\text{Ca}(\text{OH})_2$ (Lime), an azole such as 2-mercaptobenzothiazole, dimercaptobenzothiazole, benzotriazole, or proprietary azoles such as COBRATEC® 928 or COBRATEC® 939 from PMT Specialties Group, Inc. of 501 Murray Road, Cincinnati, Ohio 45217, and a proprietary vapour phase inhibitor such as VpCI-309SF™, VpCI-609™ (an ammonium carboxylate compound) or VpCI-415™ (an ethoxylated linear alcohol) from Cortec Corporation, 4119 White Bear Parkway, St. Paul, Minnesota 55110.

[0020] The corrosion inhibiting agent may alternatively be a carbon compound, for example, activated carbon or graphite. The carbon compound may bond with fluoride ions in the fire-retardant composition. This may prevent the fluoride ions from reacting with aluminum, steel, and brass equipment used to produce, store, handle and apply the fire retardant composition, and thereby reduce the corrosivity of the fire-retardant composition. The corrosion inhibiting agent may still alternatively be an ion exchange agent, for example, a zeolite which absorbs fluoride ions in the fire-retardant composition. This may likewise prevent the fluoride ions from reacting with aluminum, steel, and brass equipment used to produce, store, handle and apply the fire retardant composition and thereby reduce the corrosivity of the fire-retardant composition.

[0021] Effective composition ranges for the xanthan gum are less than or equal to 7%. Effective composition ranges for corrosion inhibiting agents are under 2% for Epsom salts ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$), below 1% for Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), less than or equal to 5% for the azoles, and less than or equal to 2% for VpCI-609™ and VpCI-309SF™. Effective composition ranges for the clay as well as MINI-U-GEL® 400 and MINI-U-GEL® FG are less than 4%. Examples of formulations of the fire-retardant composition are shown below.

[0022] Formulation 1 of the fire-retardant composition comprises by weight 91.80% ammonium polyphosphate, 1.50% attapulgite clay, 1.20% iron oxide, 1.30% xanthan gum,

0.10% Epsom salt, 0.10% 2-mercaptobenzothiazole, 1.00% benzotriazole, 2.00% VpCI-609™ and 1.00% activated carbon.

[0023] Formulation 2 of the fire-retardant composition comprises by weight 91.80% ammonium polyphosphate, 1.50% attapulgite clay, 1.20% iron oxide, 1.30% xanthan gum, 0.10% Epsom salt, 0.10% 2-mercaptobenzothiazole, 2.50% benzotriazole and 1.50% VpCI-609™.

[0024] Formulation 3 of the fire-retardant composition comprises by weight 91.75% ammonium polyphosphate, 1.50% attapulgite clay, 1.20% iron oxide, 1.30% xanthan gum, 0.15% Epsom salt, 0.10% 2-mercaptobenzothiazole, 2.50% benzotriazole and 1.50% VpCI-609™.

[0025] Formulation 4 of the fire-retardant composition comprises by weight 90.80% ammonium polyphosphate, 1.50% attapulgite clay, 1.20% iron oxide, 1.30% xanthan gum, 0.10% Epsom salt, 0.10% 2-mercaptobenzothiazole, 2.00% benzotriazole, 2.00% VpCI-609™ and 1.00% ethanolamine.

[0026] Formulation 5 of the fire-retardant composition comprises by weight 91.80% ammonium polyphosphate, 1.50% attapulgite clay, 1.20% iron oxide, 1.30% xanthan gum, 0.10% Epsom salt, 0.10% 2-mercaptobenzothiazole, 2.00% benzotriazole and 2.00% ammonium benzoate.

[0027] Formulation 6 of the fire-retardant composition comprises by weight 91.75% ammonium polyphosphate, 1.50% attapulgite clay, 1.20% iron oxide, 1.30% xanthan gum, 0.15% Epsom salt, 0.10% 2-mercaptobenzothiazole, 2.00% benzotriazole and 2.00% ammonium benzoate.

[0028] The fire-retardant compositions are formulated to pass the USDA Forest Service Specification 5100-304c as a Wet Concentrate and as a mixed (diluted) fire-retardant composition, with appropriate Health and Safety Performance, Combustion-Retarding Effectiveness, Physical Properties, and Materials Effects. Tables 1 and 2 show the formulations and corrosivity of the fire-retardant compositions disclosed herein.

What is claimed is:

1. An ammonium polyphosphate based fire-retardant composition comprising:
 - an ammonium polyphosphate;
 - a suspending agent;
 - at least two corrosion inhibiting agents, wherein the corrosion inhibiting agents are ammonium benzoate and at least one corrosion inhibiting agent selected from the group consisting of activated carbon, azoles and vapour phase inhibitors; and
 - a xanthan gum having a weight average particle diameter greater than 100 microns.
2. The ammonium polyphosphate based fire-retardant composition as claimed in claim 1, wherein the azoles are one or both of 2-mercaptobenzothiazole and benzotriazole.
3. The ammonium polyphosphate based fire-retardant composition as claimed in claim 1 or 2, wherein the corrosion inhibiting agents are ammonium benzoate, benzotriazole, and 2-mercaptobenzothiazole.
4. The ammonium polyphosphate based fire-retardant composition as claimed in claim 1, comprising vapour phase inhibitors.
5. The ammonium polyphosphate based fire-retardant composition as claimed in claim 1 or 4, wherein the vapour phase inhibitors are selected from the group consisting of ammonium carboxylate compounds and ethoxylated linear alcohols.
6. The ammonium polyphosphate based fire-retardant composition as claimed in any one of claims 1 to 5, wherein the suspending agent is a sheared clay.
7. The ammonium polyphosphate based fire-retardant composition as claimed in claim 6, wherein the sheared clay is attapulgite clay.

8. The ammonium polyphosphate based fire-retardant composition as claimed in any one of claims 1 to 7, further comprising a coloring agent.
9. The ammonium polyphosphate based fire-retardant composition as claimed in claim 8, wherein the coloring agent is an iron oxide coloring agent.
10. The ammonium polyphosphate based fire-retardant composition as claimed in any one of claims 1 to 9, further comprising a surfactant.
11. An ammonium polyphosphate based fire-retardant composition comprising:
 - an ammonium polyphosphate;
 - a sheared clay;
 - a coloring agent;
 - at least two corrosion inhibiting agents, wherein the corrosion inhibiting agents are ammonium benzoate and at least one corrosion inhibiting agent selected from the group consisting of activated carbon, 2-mercaptobenzothiazole, benzotriazole, ammonium carboxylate compounds and ethoxylated linear alcohols; and
 - a xanthan gum having a weight average particle diameter greater than 100 microns.
12. The ammonium polyphosphate based fire-retardant composition as claimed in claim 11, wherein the sheared clay is attapulgite clay.
13. The ammonium polyphosphate based fire-retardant composition as claimed in claim 11 or 12, wherein the coloring agent is an iron oxide coloring agent.
14. An ammonium polyphosphate based fire-retardant composition comprising:
 - an ammonium polyphosphate;
 - a suspending agent; and
 - at least three corrosion inhibiting agents, wherein the corrosion inhibiting agents are benzotriazole, ammonium benzoate and at least one corrosion inhibiting agent

selected from the group consisting of activated carbon, azoles, and vapour phase inhibitors; and

a xanthan gum having a weight average particle diameter greater than 100 microns.

15. The ammonium polyphosphate based fire-retardant composition as claimed in claim 14, wherein the suspending agent is a sheared clay.
16. The ammonium polyphosphate based fire-retardant composition as claimed in claim 15, wherein the sheared clay is attapulgite clay.
17. The ammonium polyphosphate based fire-retardant composition as claimed in any one of claims 14 to 16, further comprising a coloring agent.
18. The ammonium polyphosphate based fire-retardant composition as claimed in claim 17, wherein the coloring agent is an iron oxide coloring agent.
19. The ammonium polyphosphate based fire-retardant composition as claimed in any one of claims 11 to 18, further comprising a surfactant.
20. The ammonium polyphosphate based fire-retardant composition as claimed in any one of claims 11 to 19, wherein the corrosion inhibiting agents are ammonium benzoate, benzotriazole, and 2-mercaptobenzothiazole.

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DESSIN PUISQU'ILS ONT ETE
ANNULE PAR LE DEMANDEUR
AVANT LA DELIVRANCE.

THIS PATENT DOES NOT CONTAIN
ANY DRAWINGS AS THEY WERE
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