

Security cabinet

The invention concerns a security cabinet having the features of patent claim 1.

- 5 Security cabinets, also described as safes, vaults, steel cabinets or value protecting cabinets, have varied constructions according to the state-of-the-art. Security cabinets are also used for automatic teller machines. Automatic teller machines comprise, as a rule, a PC according to the industry standard, with special peripheral equipment connected and a security cabinet in which the cash
10 is stored in boxes to protect it from being accessed by third parties.

As a rule, such a security cabinet comprises flat steel plates that are welded at the corners. The body may be made from two- or multiple-layer combinations of materials to provide an increased protection against mechanical and thermal
15 threats, like for example cutting with grinders or welding flames.

In addition to the method of breaking up by drilling or cutting, the threat by blowing up has been increasing. In this case flammable gas is introduced through a small aperture into the interior of the security cabinet and then ignited. In this
20 case usually the hinges of the door and the lock are subjected to overload, so that the door will fly out. In addition, the body can deform due to the high pressure, so that the welding seams in the corners will break up.

Conventional security cabinets have the additional disadvantage, that due to the
25 thick walls they are very heavy. On the one hand this is desirable as it makes transporting more difficult. It is, however, a disadvantage in the case of automatic teller machines due to the considerably greater transport costs. In addition, in the case of automatic teller machines an as large as possible interior of the security cabinet is strived for, since the storage boxes for the money and the complex
30 banknote feeding systems require a large installation space.

DE 10 2005 014 298 A1, disclosing armour-plating for a vehicle, is part of the technological background.

DE 1 250 642 B describes the use of a hardened nickel-chromium alloy with improved strength properties.

Thus the object of the invention is to produce a security cabinet that is
 5 manufactured from metal plates which make the use of thin walls and consequently a weight reduction and the maximising of the interior possible on the one hand, and in addition can be so technologically processed that the geometry of the metal plates can accommodate also explosive loads acting from within on the security cabinet.

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This objective is achieved with a security cabinet having the features of claim 1.

Advantageous developments of the basic idea of the invention are subjects of the subclaims.

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The security cabinet according to the invention is characterised by that the metal plates of the housing and/or of the door are made from a steel with the following composition, expressed in percentage by weight:

	Carbon	0.1 to 0.5 %
20	Silicon	0.1 to 1.0 %
	Manganese	0.2 to 2.0 %
	Phosphorus	max. 0.02 %
	Sulphur	max. 0.02 %
	Aluminium	max. 0.1 %
25	Copper	max. 0.5 %
	Chromium	0.05 to 18 %
	Nickel	max. 2.0 %
	Molybdenum	0.1 to 1.0 %
	Boron	0.0005 to 0.01 %
30	Tungsten	0.001 to 1.0 %
	Nitrogen	max. 0.05 %
	Titanium	max. 0.5 %
	Vanadium	max. 0.5 %
	Niobium	max. 0.5 %

The remainder is iron and impurities caused by the smelting process. The metal plates are hot formed and brought to a shape to enable to weld them with adjacent metal plates to the housing of the security cabinet.

- 5 Hot formed heat-treated steels are characterised by very great hardness and tensile strength. Due to this these steels have an increased resistance to drilling, enabling a reduction of the wall thickness. The decrease of the wall thickness, made possible by the invention, leads to an increase of the interior, while the external dimensions remain unchanged, what is of particular advantage for
- 10 security cabinets of automatic teller machines. Due to the lesser weight the installation of automatic teller machines is made markedly easier since the floors of the buildings will be under considerably lower load due to the reduced weight. By virtue of this expensive reinforcing steps of the building can be omitted. In addition, due to the lower weight the transport is considerably simpler and easier.
- 15 Since security cabinets of automatic teller machines are secured by being bricked in or some other type of anchoring, a reduced weight of the security cabinet is not a disadvantage as far as security is concerned.

- If, in contrast, no reduction of the wall thickness of the metal plates is required,
- 20 the resistance to drilling is markedly increased by using of the proposed steel alloy.

The metal plates of the housing and/or of the door are preferably made from a steel with the following composition, expressed in percentage by weight:

- 25 Carbon 0.2 to 0.4 %
 Silicon 0.1 to 1.0 %
 Manganese 0.5 to 2.0 %
 Phosphorus max. 0.02 %
 Sulphur max. 0.02 %
- 30 Aluminium max. 0.1 %
 Copper max. 0.5 %
 Chromium 0.05 to 0.5 %
 Nickel max. 2.0 %
 Molybdenum 0.1 to 1.0 %

	Boron	0.0008 to 0.01 %
	Tungsten	0.001 to 1.0 %
	Nitrogen	max. 0.05 %
	Titanium	max. 0.5 %
5	Vanadium	max. 0.5 %
	Niobium	max. 0.5 %

The remainder is iron and impurities caused by the smelting process.

- Alternatively, the metal plates of the housing and/or of the door are made from a steel with the following composition, expressed in percentage by weight:

	Carbon	0.1 to 0.5 %
	Silicon	0.1 to 1.0 %
	Manganese	0.2 to 2.0 %
	Phosphorus	max. 0.02 %
15	Sulphur	max. 0.02 %
	Aluminium	max. 0.1 %
	Copper	max. 0.5 %
	Chromium	5 to 18 %
	Nickel	max. 2.0 %
20	Molybdenum	0.1 to 1.0 %
	Boron	0.0005 to 0.01 %
	Tungsten	0.001 to 1.0 %
	Nitrogen	max. 0.05 %
	Titanium	max. 0.5 %
25	Vanadium	max. 0.5 %
	Niobium	max. 0.5 %

The remainder is iron and impurities caused by the smelting process.

- The above steel alloy has an increased chromium content. By virtue of the great hardness that can be achieved, the alloy is well suited against mechanical attacks. Due to the higher chromium content the steel has a better resistance against thermal attacks by cutting by oxyacetylene flame or the like.

According to the invention the metal plates are hot formed. In a preferred state the plates are processed in the rolling mill in unhardened, soft state and brought to the desired structure for shaping by hot forming and tool hardening. For the hot forming process the plate is heated prior to the last shaping step to a temperature
 5 above the AC3 point and subsequently shaped in a press tool, in which it is preferably also hardened. The hardening in the tool should be so far progressed that no distortion or only a negligible one will occur when the tool is opened. Therefore it is not absolutely necessary for the hardening to take place in the tool up to the martensite finish temperature. Therefore the further cooling to room
 10 temperature can take place in the open tool or even outside of the tool. By virtue of this modus operandi hot formed metal plates with great hardness and tensile strength with good dimensional stability can be produced.

For the hardenability of the steel boron is added to it. To suppress the formation
 15 of boron nitride and to have non-bonded boron in the steel, titanium is added to the alloy. Due to this preferably titanium nitride is formed, so that the boron is available for the hardenability of the steel. The invention provides that titanium is added to the alloy in a ratio of 3.0 to 4.0 to the nitrogen content. Ideally, titanium in a 3.4 Ti/N ratio to the nitrogen content is added to the alloy.

20 The metal plates have a tensile strength of 1200 to 2000 MPa and a HV30 hardness of 300 to 600.

It is further considered as useful when the steel is carburised up to a depth of 2
 25 mm with a boundary carbon content of up to 0.8 %. With the case hardening it will be achieved that the metal plates will have a ductile core with a simultaneously hard surface. In this manner the metal plates have the necessary resistance to deformation to withstand explosions, yet at the same time the necessary hardness to resist attempts to be drilled through.

30 The actual hardening of the metal plates is carried out following the carburisation. As a result of this a pattern of the hardening depth, characteristic for this material, is obtained. Following the hardening a possible a short tempering may follow to impart slightly more ductility to the hard martensitic edge layer again.

Theoretically it is also possible to employ the types of steels used as a hardened flat plate. In this case, however, the forming operations can be realised only within limits. Individual parts had to be cut out from the flat plate by laser and joined with one another. It is considered advantageous to have hot formed metal plates of the housing joined with one another in a materially bonded manner, while the butt joints of the metal plates joined with one another are outside of the corner regions of the housing. Therefore the metal plates have an L- or U-shaped cross-section and are welded and/or soldered with one another outside the corner regions. In this manner the corner regions, where the stresses are critical, are not subjected to additional weakening by thermally induced changes of the joints in the region of the weld-influenced zone.

By virtue of the hot forming of the metal plates and the moving of the positions of the welding seams the housing can be rounded in the corner region, resulting in a greater resistance against the explosions acting from within. This could also be explained by the fact that butt-welded seams are more advantageous than fillet-welded ones.

It is possible to manufacture the security cabinet from composite material. In particular the housing may be multi-layered, whereby the metal plates form the external shell of the housing/of the door from the types of steels used within the scope of the invention. The combination with further metallic plates, synthetic materials, insulating materials or with mineral materials like concrete, is also conceivable within the scope of the invention. Of course, in the case of a multi-layer construction not only the external shell can be manufactured from the types of steel used according to the invention, but the internal shell of the housing/of the door can be also manufactured from the types of steel according to the invention.

From the practical point of view a wall thickness of 2.5 mm to 15 mm is considered particularly advantageous for the metal plates. The wall thickness is preferably between 4 mm and 6 mm. For this reason, when compared with conventional security cabinets, especially with safes, a marked weight reduction can be achieved.

- It is a further advantage when the metal plates of the security cabinet have a structure that increases their rigidity. Such a rigidity increasing structure can be achieved by forming beads and/or embossings in the surface of the metal plates or also by adjustments in the edge regions. The production of the rigidity
- 5 increasing structure in the metal plates is preferably carried out within the scope of the hot forming with subsequent press hardening. The rigidity increasing structure reinforces the walls of the security cabinet and consequently the resistance against buckling. Due to this the resistance against mechanical attacks, for example by forcing open of the walls, can be increased.

Patent claims

1. Security cabinet with a housing and a door mounted on the housing, wherein the housing and the door are constructed from metal plates, characterised in that the metal plates of the housing and/or of the door are made from a steel with the following composition, expressed in percentage by weight:

	Carbon	0.1 to 0.5 %
	Silicon	0.1 to 1.0 %
10	Manganese	0.2 to 2.0 %
	Phosphorus	max. 0.02 %
	Sulphur	max. 0.02 %
	Aluminium	max. 0.1 %
	Copper	max. 0.5 %
15	Chromium	0.05 to 18 %
	Nickel	max. 2.0 %
	Molybdenum	0.1 to 1.0 %
	Boron	0.0005 to 0.01 %
	Tungsten	0.001 to 1.0 %
20	Nitrogen	max. 0.05 %
	Titanium	max. 0.5 %
	Vanadium	max. 0.5 %
	Niobium	max. 0.5 %

The remainder is iron and impurities caused by the smelting process, while the metal plates are hot formed.

2. Security cabinet according to claim 1, wherein the steel has the following composition, expressed in percentage by weight:

	Carbon	0.2 to 0.4 %
30	Silicon	0.1 to 1.0 %
	Manganese	0.5 to 2.0 %
	Phosphorus	max. 0.02 %
	Sulphur	max. 0.02 %
	Aluminium	max. 0.1 %

	Copper	max. 0.5 %
	Chromium	0.05 to 0.5 %
	Nickel	max. 2.0 %
	Molybdenum	0.1 to 1.0 %
5	Boron	0.0008 to 0.01 %
	Tungsten	0.001 to 1.0 %
	Nitrogen	max. 0.05 %
	Titanium	max. 0.5 %
	Vanadium	max. 0.5 %
10	Niobium	max. 0.5 %
The remainder is iron and impurities caused by the smelting process.		

3. Security cabinet according to claim 1, wherein the steel has the following composition, expressed in percentage by weight:

15	Carbon	0.1 to 0.5 %
	Silicon	0.1 to 1.0 %
	Manganese	0.2 to 2.0 %
	Phosphorus	max. 0.02 %
	Sulphur	max. 0.02 %
20	Aluminium	max. 0.1 %
	Copper	max. 0.5 %
	Chromium	5 to 18 %
	Nickel	max. 2.0 %
	Molybdenum	0.1 to 1.0 %
25	Boron	0.0005 to 0.01 %
	Tungsten	0.001 to 1.0 %
	Nitrogen	max. 0.05 %
	Titanium	max. 0.5 %
	Vanadium	max. 0.5 %
30	Niobium	max. 0.5 %

The remainder is iron and impurities caused by the smelting process.

4. Security cabinet according to any one of claims 1 to 3, characterised in that titanium is added to the alloy in a ratio of 3.0 to 4.0 to the nitrogen content, preferably in a 3.4 titanium/nitrogen ratio.
- 5 5. Security cabinet according to any one of claims 1 to 4, characterised in that the metal plates have a tensile strength of 1200 to 2000 MPa.
6. Security cabinet according to any one of claims 1 to 5, characterised in that the metal plates have a HV30 hardness of 300 to 600.
- 10 7. Security cabinet according to any one of claims 1 to 6, characterised in that in its edge layer the metal plates have a boundary carbon content of up to 0.8 % up to a depth of 2 mm.
- 15 8. Security cabinet according to any one of claims 1 to 7, characterised in that the metal plates are hardened and tempered.
9. Security cabinet according to any one of claims 1 to 8, characterised in that the metal plates of the housing are joined with one another in a materially
20 bonded manner.
10. Security cabinet according to claim 9, characterised in that the butt joints of the metal plates joined with one another are outside of the corner regions of the housing.
- 25 11. Security cabinet according to any one of claims 1 to 10, characterised in that the housing and/or the door are constructed multi-layered, whereby the metal plates form an external shell of the housing/of the door.
- 30 12. Security cabinet according to any one of claims 1 to 11, characterised in that the metal plates form an internal shell of the housing/of the door.

13. Security cabinet according to any one of claims 1 to 12, characterised in that the wall thickness of the metal plates is between 2.5 mm and 15 mm preferably between 4 mm and 6 mm.
- 5 14. Security cabinet according to any one of claims 1 to 13, characterised in that the metal plates have a structure that increases their rigidity.
- 10 15. Security cabinet according to any one of claims 1 to 14, characterised in that one deals with a safe, a steel cabinet, a value protecting cabinet or an armour-plated money cabinet, in particular a component of an automatic teller machine.