L. H. BAEKELAND.

MACHINE ELEMENT.

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1,160,364.

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Fig. 1.

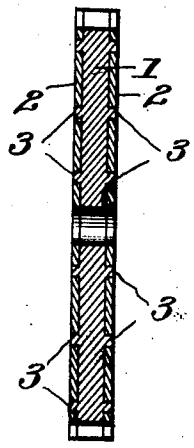


Fig. 2.

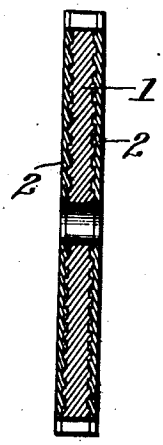


Fig. 3.

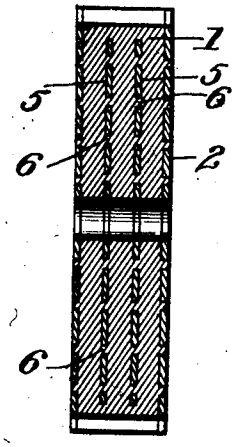


Fig. 4.

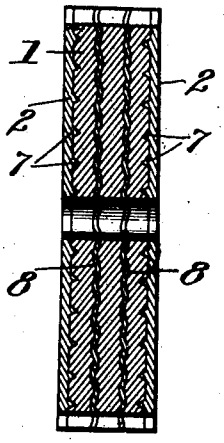
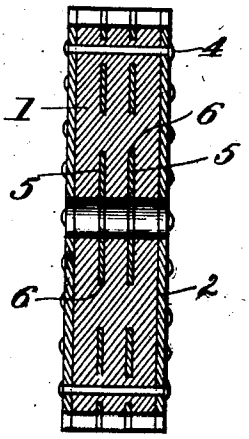


Fig. 5.



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UNITED STATES PATENT OFFICE.

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MACHINE ELEMENT.

1,160,364. Specification of Letters Patent. Patented Nov. 16, 1915.

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To all whom it may concern:

Be it known that I, LEO H. BAEKELAND, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Machine Elements, of which the following is a specification.

This invention relates to the manufacture of gears, pulleys and other machine elements, one of the principal objects of the invention being the provision of elements of this character which, while having the requisite strength, resistance to wear, and inertness to oils and other lubricants, shall be relatively noiseless in operation as compared with metal gears.

A further object of the invention relates to the manufacture of such elements, combined with graphite or similar solid lubricants in such manner as to render them self-lubricating in operation.

I have found that certain condensation products of phenolic bodies and formaldehyde or their equivalents, which, after being subjected under proper conditions to the action of heat become hard, infusible and extremely resistant to chemical agents including vegetable and mineral oils, greases, etc., are particularly adapted for the purposes above defined. Such condensation products, particularly when compounded with suitable filling materials, usually of a fibrous character, are readily cut into the desired forms; or they may be directly molded into such forms. The articles so prepared possess a high compressive strength but a relatively lower tensile strength, and for this reason it is found necessary in practice to use the compositions in combination with appropriately designed metallic reinforcing members.

In order to produce a gear, as an illustrative example of the invention, I may proceed as follows: From a sheet of metal, usually steel or brass, I cut or stamp a number of appropriately formed plates or disks, these plates being preferably perforated, ribbed, corrugated, studded, pitted, scored, or otherwise formed to unite or interlock with and firmly retain the composition. The composition, either in the form of previously formed sheets or as a plastic mass, is then interposed between the metal plates and the whole is consolidated under high pressure, preferably in a heated hydraulic press. The composition possesses such degree of plasticity that under this pressure it may be forced through the perforations of the plates, or into the recessed portions of the plates, and the whole structure becomes firmly consolidated. At the same time the condensation product in the composition undergoes a chemical transformation (polymerization) whereby it loses its plastic character and becomes hard, infusible, and resistant to solvents as above noted.

A condensation product suited for use as above may be prepared by heating commercial phenol or cresol, their homologues or mixtures, with commercial formaldehyde, in approximately equal volumes. The reaction is facilitated by the use of suitable accelerating or condensing agents, as bases, acids or salts. The resultant product, after elimination of water, appears as a more or less viscous liquid, or in case the reaction has been permitted to proceed further, it may appear as a pasty mass or even as a brittle solid, which may however be liquefied by heat. All of these forms are soluble in alcohol, acetone and phenol, but possess the property of undergoing transformation, upon sufficient heating, into an insoluble and infusible mass. For convenience of reference the soluble condensation products will be referred to as "partial condensation products." The insoluble product derived therefrom by heating may be designated the "final condensation product."

The filling materials with which the partial condensation products are compounded are preferably but not necessarily fibrous in character, as for example wood fiber, asbestos or the like; or sheets or plates of wood, cardboard, paper or similar porous materials may be impregnated with the liquid or dissolved partial condensation products, such impregnated sheets or plates being inserted between the metal plates.

After the composite structure has been consolidated and hardened as above described, it may be turned, cut or otherwise fashioned into the desired form; for example, gears may be cut from disks in gear-cutting machines of the usual type. Or the operation may be simplified by the use of appropriate molds in which the article may be pressed directly into the desired form, thereby avoiding further machining or mill-

ing, or reducing such finishing operations to a minimum.

The structure may be further reinforced by any desired means, as for example by bolts or rivets securing the metal plates, by external reinforcing plates or members, etc.

In a simple embodiment the structure may comprise opposite side plates of metal, with an intermediate layer of the above-described composition, the side plates being bolted or riveted together through the intermediate layer, or otherwise adapted to interlock therewith. In order to strengthen the device to the degree desired, any required number of intermediate metal plates may be provided, these intermediate plates also being preferably perforated or otherwise fashioned to interlock with the composition, whereby the whole is united into a unitary structure.

Gears and other machine elements so constructed possess the advantage that they are quite unaffected by water, steam, or oils, and may be operated in casings filled with oil. They are capable of withstanding comparatively high temperatures and in general of enduring conditions which are destructive to most plastic compositions. They possess great hardness and toughness and excellent wearing qualities. They present the advantage as compared with metal gears that they are comparatively silent in operation.

For certain purposes, it has been found desirable to incorporate with the composition, before hardening the same, a suitable proportion, as for example 10 per cent., by weight of the mass, of graphite. The graphite serves its usual function as a lubricant and enhances the smooth-running and noiseless character of the gear.

Certain specific illustrative embodiments of the invention are shown in the accompanying drawing, wherein:—

Figures 1 to 5, inclusive, are transverse central sectional views of toothed gear wheels formed in accordance with the invention.

In all of said figures 1 represents the compositions containing the hard, infusible and insoluble condensation products of phenolic bodies and formaldehyde.

In Fig. 1 the composition is illustrated as lying between perforated metal plates 2 and in the perforations 3 formed in said plates. In Fig. 2 the composition 1 is overlaid on each side by internally recessed metal plates 2. Fig. 3 shows a construction similar to that of Fig. 1, except that there are also provided internal metallic reinforcing plates 5 perforated at 6. Fig. 4 shows external plates 2 having inwardly directed projections 7; this figure also illustrates the use of internal corrugated reinforcing members 8, which may or may not be perforated. Fig. 5 illustrates the use of external reinforcing members 2, secured by rivets or bolts 4, and provided also with internal reinforcing members 5 perforated at 6.

I claim:

1. A machine element, comprising a plurality of substantially parallel, spaced, metallic reinforcing-members, in combination with a homogeneous and non-plastic body lying between said members and interlocking therewith, said body consisting essentially of a hard, infusible, insoluble and non-plastic phenolic condensation product compounded with a fibrous filling material.

2. A machine element, comprising a plurality of substantially parallel, spaced, perforated, metallic reinforcing-plates, in combination with a homogeneous and non-plastic body lying between said plates and interlocking through the perforations thereof, said body consisting essentially of a hard, infusible, insoluble, and non-plastic phenolic condensation product, compounded with a fibrous filling material.

In testimony whereof, I affix my signature in presence of two witnesses.

LEO H. BAEKELAND

Witnesses:
HERBERT S. MAY,
WM. S. GORDON, JR.