May 22, 1945. C. E. UNGER 2,376,639

CENTRIFUGAL THROWING WHEELS

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Fig. 2

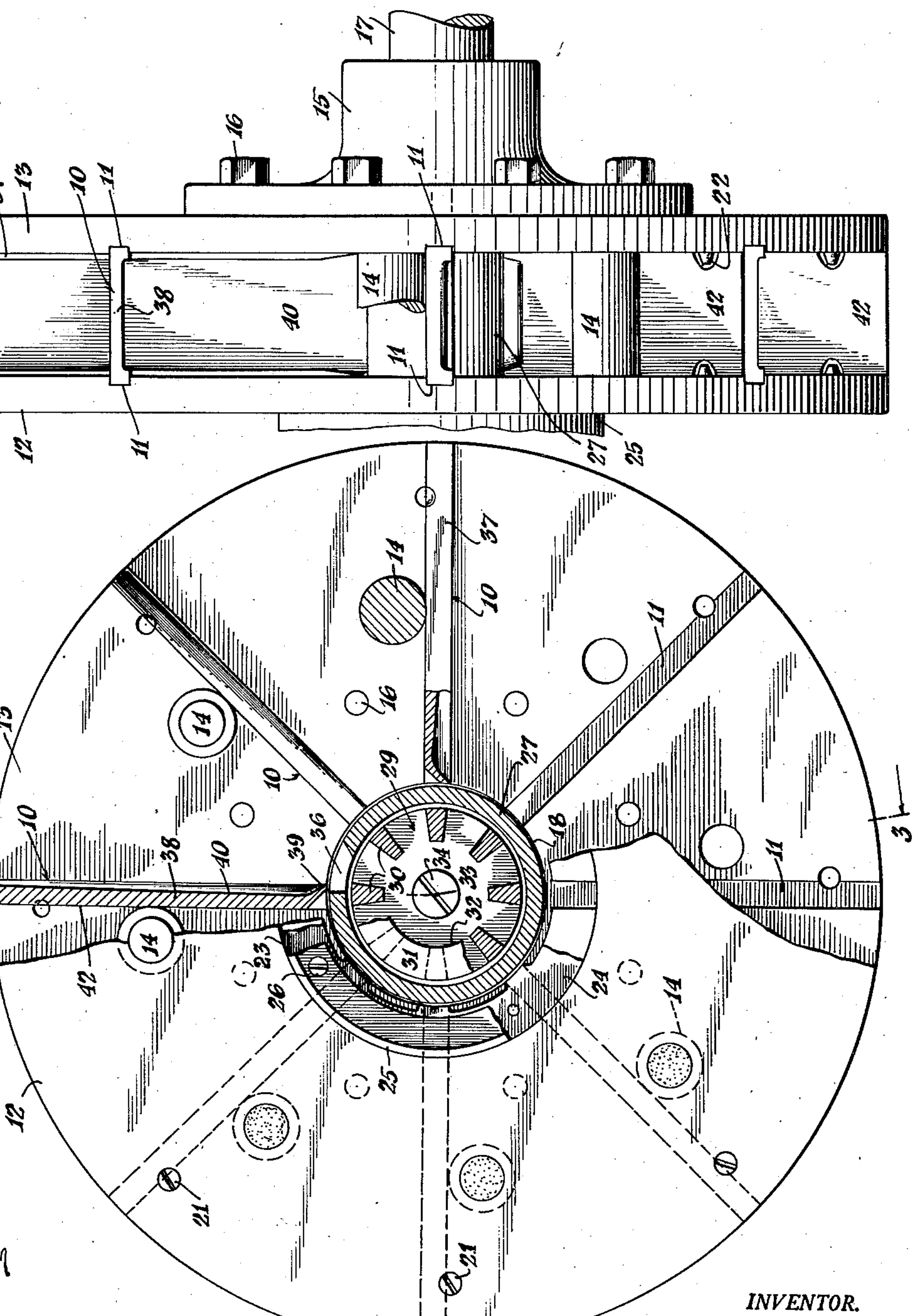

Fig. 1

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Fig. 4

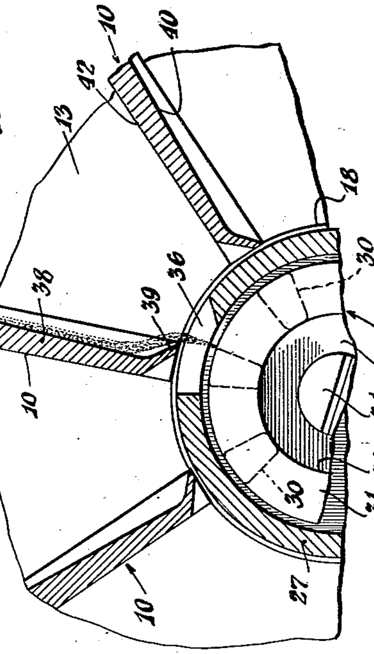


Fig. 6

Fig. 5

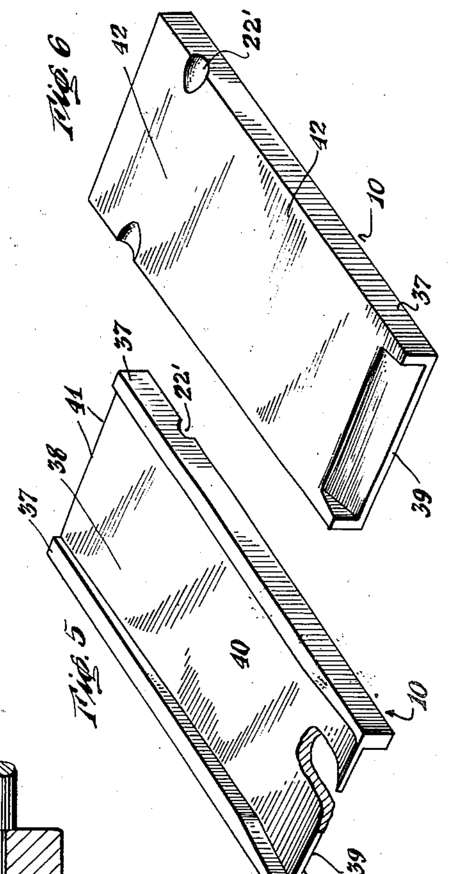
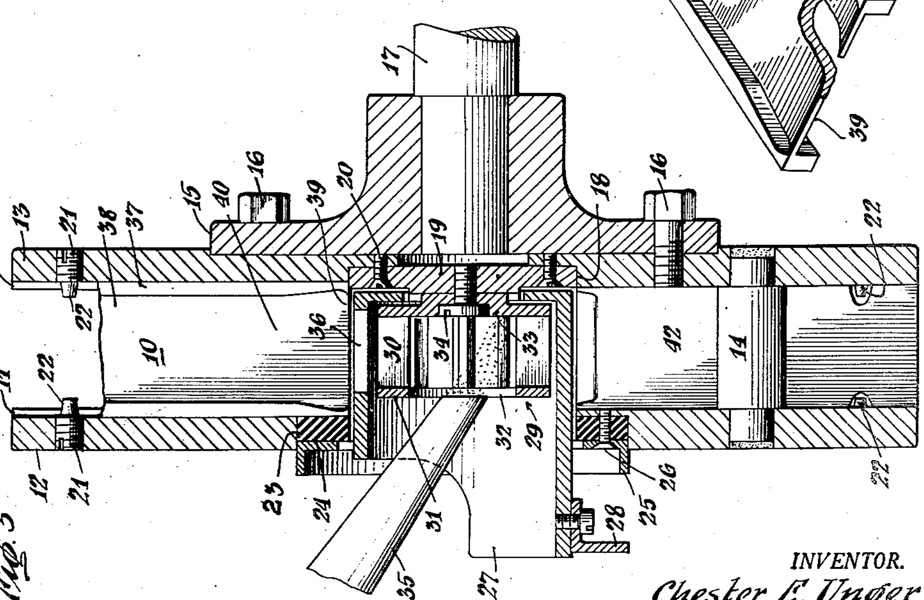


Fig. 3



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UNITED STATES PATENT OFFICE

2,376,639

CENTRIFUGAL THROWING WHEEL

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Application December 14, 1943, Serial No. 514,217

3 Claims. (Cl. 51—9)

This invention relates to improvements in centrifugal throwing wheels and more particularly to improved throwing blades for use in such wheels.

The invention relates more particularly to a ferrous alloy possessing outstanding characteristics and superior qualities which make the alloy particularly suited for blades in centrifugal throwing wheels.

Blades made from the improved alloy possess a durability heretofore unattained and permit more efficient operation of the wheels in which they are installed. A further feature resides in the fact that they may be manufactured at a lower cost than the best blades heretofore available.

Centrifugal throwing wheels are widely used in the industry. They are employed, for example, in the cleaning of metal parts such as castings, forgings, bars, billets, sheets and like materials by directing a stream of abrasive such as steel grit or quartz sand at a high velocity against the surface to be cleaned.

Centrifugal throwing wheels are also employed in the surface hardening or cold working of metal parts. In this application a stream of steel shot is directed against the surface at high velocity indenting or "peening" the surface with the result of increased surface hardness of the workpiece.

Centrifugal throwing wheels are capable of discharging 300 pounds to 400 pounds of abrasive per minute and impart to the projected particles a velocity of the order of about 200 feet per second.

The structure of centrifugal throwing wheels is commonly known and is disclosed, for example, in the patent to Unger No. 2,162,139, dated June 13, 1939. Basically the wheel comprises a plurality of substantially radially extending throwing blades usually mounted between side wall discs. The blades extend from the periphery of the wheel inwardly and terminate short of the axis of the wheel so as to define a central space or opening.

The direction of discharge of the abrasive or shot particles is controllable by means of a tubular control member extending into the central space. The control member is stationary relative to the wheel and has a discharge opening in its peripheral wall through which the particles reach the inner end of the throwing blade. The discharge opening in the control member is of limited peripheral length and may be brought into any desired clock-dial position by manual adjustment of the control member for the purpose of directing the particle discharged in any particular direction.

Abrasive or shot particles are fed into the interior of the control member in an appropriate manner, such as by gravity, and are propelled through the discharge opening of the control member by suitable means such as a rotary impeller having a number of substantially radial blades. After passing through the discharge opening the particles come within the reach of the throwing blades and are rapidly accelerated by the blade toward the periphery of the wheel where they are discharged at a high abrading velocity.

Centrifugal throwing wheels of the type described in the patent to Unger No. 2,162,139 are widely used in the industry and have generally a diameter of approximately 20 inches. They are operated at a speed of between 2000 and 2500 R. P. M. imparting to the peripheral portions of the blades a linear velocity of approximately 200 feet per second while discharging a stream of particles at a rate of approximately one ton of abrasive in five to eight minutes.

It is easily apparent that the large volumes of abrasive particles moving along the advancing face of the blades at a high rate tend to abrade the blades to a point where the blades are either destroyed or no longer safe to use at the high operating speeds of the wheel.

A further factor affecting the life of the throwing blades is the rebound of abrasive or shot from the workpiece. Although the greater part of the projected particles clears the wheel and falls into a hopper for reuse, a certain amount of shot or abrasive rebounds from the workpiece and strikes the blade at a high velocity. Assuming a particle rebounds at a velocity of 100 feet per second and strikes a blade moving at a tip velocity of 200 feet per second, it is apparent that the impact of the particle on the blade at a relative speed of 300 feet per second has a wearing effect on the blade and tends to shorten its life particularly in cases where highly abrasive particles such as steel grit are employed.

It is the principal object of this invention to provide a blade of a particular metallic composition which renders the blade highly resistant to the scouring and impact action of the abrasive and shot particles, resulting in a greatly increased life of the blade.

The improved blade may be formed from the improved metal composition by casting, and possesses considerable hardness combined with toughness which is of greatest importance, if the blade is to stand up under the impact of rebounding coarse abrasive or shot.

These and further features and advantages and details of the invention will appear more fully from a consideration of the detailed description which follows accompanied by drawings showing, for purely illustrative purposes, a form of throwing wheel and blade to which the invention may be applied.

Although the novel features which are believed to be characteristic of the invention will be particularly pointed out in the claims appended hereto, the invention itself, its objects and advantages, and the manner in which it may be carried out may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part hereof in which:

Fig. 1 is a side view of a centrifugal throwing wheel, certain parts being broken away to show its structure;

Fig. 2 is a front elevation of the wheel shown in Fig. 1;

Fig. 3 is a cross-sectional view of the wheel shown in Fig. 1, the section being taken on line 3—3;

Fig. 4 is a detailed sectional view on an enlarged scale of the central portion of the wheel;

Fig. 5 is a perspective top view of a preferred form of the throwing blade, the leading face of the blade facing the observer; and

Fig. 6 is a perspective bottom view of the blade shown in Fig. 5.

Similar reference characters refer to similar parts throughout the several views of the drawings.

The illustrated throwing wheel comprises a plurality of throwing blades 10 inserted in substantially radially extending grooves 11 in outer and inner side wall discs 12 and 13 respectively. The side wall discs 12 and 13 are connected by studs 14. The inner side wall disc 13 is mounted to a central flange or hub 15 by means of bolts 16. The hub 15 is secured to a shaft 17 which drives and supports the wheel. The inner side wall disc 13 has a central aperture 18 into which is fitted a center disc 19 held in place by screws 20. The thickness of the center disc 19 is such that the disc extends with its periphery into the path of the radial grooves 11 to provide a stop for the blades inserted from the periphery of the wheel. After insertion the blades 10 are held securely in place by means of set screws 21 in the outer and inner side wall discs. The set screws are provided with conical points 22 which fit into corresponding notches 23 in the throwing blades.

The outer side wall disc 12 also has a central aperture 23 into which a packing ring 24 is inserted securely held in place by means of a flange ring 25 and screws 26. A control member or sleeve 27 extends through the aperture 23 into the central portion of the wheel. The control sleeve 27 is supported by a bracket 28 permitting manual adjustment of the sleeve about its axis in a conventional manner not shown in detail.

A rotary impeller 29 is arranged inside the control member. It consists of a plurality of substantially radial blades supported between an outer disc 31 having a central aperture 32 and an inner disc 33. The inner disc 33 is secured to the center disc 19 of the wheel by a screw 34 causing the impeller 29 to rotate at the same angular velocity as the wheel.

A supply conduit 35 for abrasive or shot particles is arranged to discharge the particles onto the impeller blades through the central aperture 32 of the impeller 29. The particles are propelled by the impeller blades 30 through a peripheral aperture 36 in the control sleeve 27 and moved into the path of the throwing blades 10 of the wheel. Due to the rotation of the wheel the particles are centrifugally accelerated and leave the outer ends on the throwing blades at a high velocity.

A preferred form of throwing blade is shown in Figs. 5 and 6, a cross-section of which is also found in Fig. 1. The throwing blades have side walls 37 of a height corresponding to the width of the groove 11 into which the blades are inserted. A body portion 38 extends between the side walls and forms a relatively thin lip 39 at the inner end of the throwing blade. The lip 39 of the throwing blade 10 receives abrasive or shot particles through the aperture 36 in the control member 27, the arrangement of the lip 39 of the throwing blade relatively to the impeller blade 30 being preferably such that the impeller blade 30 is in advance of the lip so as to discharge an unbroken flow of abrasive onto the leading face 40 of the throwing blade. The body portion of the throwing blade increases in thickness from the lip portion 39 towards the peripheral portion 41 to allow for increased wear of the blade due to the increased velocity of the particles at the outer portion of the throwing blade.

The trailing face 42 of the blades is substantially plane and carries the two indentations 23 for the set screws.

As will be seen from Fig. 1, the arrangement of the studs 14 with respect to the blades 10 is such as to permit an unobstructive flow of abrasive or shot particles along the leading face of the blades, the studs being arranged adjacent to trailing face 42 of the blades.

The direction of discharge of the particles from the wheel may be controlled by an appropriate adjustment of the aperture 32 in the control member 27 into a predetermined clockdial position.

In the operation of the machine it is of great importance that the leading face of the blades wears slowly and uniformly under the flow of the abrasive or shot particles without the formation of channels or grooves which would lead to an uneven distribution of the particles in the stream discharged by the wheel.

It is also essential that the blades be tough to resist chipping or breaking under the constant impact of rebounding particles striking the blades at high velocity.

The blade material should further be such as to retain a smooth and slippery surface regardless of the degree of wear in order to facilitate the flow of particles on the blade surface.

It is further important that the characteristic of the blade material be the same for every point of the cross-section of the blade, and that the blades are free from an objectionable degree of internal stress frequently produced if the material is quenched in a suitable medium such as oil for the purpose of hardening it.

I have found that these requirements and characteristics are met by a blade material, having the following composition:

Formula A

	Per cent (by weight)
Carbon	Less than 1.5
Silicon	0.50 to 0.90
Manganese	0.50 to 0.90
Chromium	0.90 to 1.40
Molybdenum	1.40 to 1.90

The balance being substantially pure iron.

An outstanding performance and an operating life of over 100 hours under severe operating conditions were obtained with blades made according to the following formula:

Formula B

	Per cent (by weight)
Carbon	1.20 to 1.35
Silicon	0.60 to 0.80
Manganese	0.60 to 0.80
Chromium	1.00 to 1.30
Molybdenum	1.50 to 1.80

The balance being substantially pure iron.

In each of the above formulas the content of impurities should be less than 0.05% by weight of phosphorus and less than 0.05% by weight of sulfur.

The aggregates for Formula B may consist substantially of the following for each 100 pounds:

Formula C

	Pounds	Ounces
Mild steel scrap	91	10
Ferrosilicon cont. 50% Si	1	11
Ferromanganese cont. 80% Mn	1	3
Ferrochrome cont. 70% Cr	1	14
Ferromolybdenum cont. 65% Mo	2	3
Carbon	1	7
Inoculating alloy "V7"	1	-------
	100	

The term "mild steel scrap" is used to define the steel scrap containing 0.3% carbon or less with negligible amounts of alloying elements. It is obvious that the amount of carbon in the Formula C must be adjusted according to the carbon content of the steel scrap used in each case to produce an alloy having the carbon content defined in Formula A or B, as the case may be. In the specific example of Formula C the mild steel scrap contained 0.20% carbon.

The inoculator is a commercially available chromium foundry alloy known to the trade as "V7" and produced by the Vanadium Corporation of America. Its nominal composition is as follows: chromium 28–32%, silicon 15–21%, and manganese 14 to 16%.

The improved blade metal may be prepared as follows:

In the electric furnace, preferably of the three-phase direct-arc type, the steel scrap is first melted together with sufficient sand to form a protecting blanket on the steel. Before the charge is melted the required amount of "V7" deoxidizer is added. After the charge is melted the slag is removed with an iron rake bar and ferro silicon, manganese, chromium and, if required, carbon are added to the clean bath. The constituents are then stirred up well with an iron rake bar until they are melted. Then sufficient silica sand is added to form a slag covering and the doors and openings of the furnace are tightly closed to prevent an escape of the gases and to exclude the atmospheric air. The temperature of the furnace is then increased to 2700 degrees Fahrenheit, at which point the molten metal is poured into a pouring ladle. The temperature of the metal in the ladle is carefully checked with a pyrometer, and after cooling to 2650 degrees Fahrenheit the metal is ready for pouring. The mold is prepared of what is generally referred to in the art as "green sand," that is the mold is not baked. The mold should be strong enough to hold its form until the metal cools, thus preventing shrinkage strains from being produced in the casting.

A sand having the following characteristics will produce excellent results:

Strength	7 to 9 lbs. per sq. in.
Permeability	About 30 American Foundries Assn. units.
Moisture content	4 to 4.4%.

The sand may be prepared as follows:

	Parts (volume)
Old sand	56
Silica sand	4
Clay sand	4
Bentonite	3
Sea coal	3

The sand is mulled dry for several minutes after which water is added to produce the above specified moisture content. It is tested for its strength and permeability and is then ready for use.

The molds are prepared to include preferably three blades gated together with one common riser, the arrangement of the cavity for the blade proper being such that the blade is cast with its leading face downward, preferably inclined 10 degrees with respect to the horizontal.

During the pouring the slag which accumulates on the surface of the metal is carefully skimmed off and held back from the pouring stream of metal.

After the pouring the mold is allowed to rest undisturbed for ten minutes and is then turned over on the floor and the castings removed immediately for a subsequent quenching of the steel. Very satisfactory results are obtained by quenching in air. For this purpose the castings which were removed from the mold are so placed as to permit good circulation of the air to insure an even cooling of the blades.

Excellent results are obtained by quenching in oil. This may be conveniently done immediately after the removal of the castings from the mold while the blades have a temperature of approximately 1600° F. However, it may also be done at any time after the casting has cooled in which event the blades are first heated to approximately 1600° F. and then quenched in oil.

The quenched and hardened blades may be subjected to an additional surface treatment. For this purpose they may be placed in a peening machine for thorough peening with No. 20 shot which has a diameter of approximately .046 inch. It was found that blades so peened show an exceptional resistance to fatigue.

Throwing blades made from the ferrous alloy set forth in the formulas given above possess physical properties surpassing any alloy known or used heretofore in centrifugal throwing machines. The novel blade alloy is sufficiently hard to resist the abrading action of the abrasive or shot particles. It is of extreme toughness to withstand the impact of particles rebounding from the workpiece. Blades cast from the alloy were found uniform throughout their cross-section and free from internal stress due to its superior quenching qualities. The novel blades were found to wear evenly without the formation of channels in the leading blade surface, which would tend to deflect the abrasive and possess a smooth and slippery surface at any degree of wear.

A particular feature of the blade alloy is its air quenching property which makes a subsequent heat treatment dispensable in most instances.

A further and outstanding feature is the low cost of the alloy resulting from the low percentage of the alloying elements, such as chromium, molybdenum, silicon and manganese.

The relatively low carbon content is notable. I have found that an increase of the carbon content to more than 1.5% will adversely affect the suitability of the alloy as a material for throwing blades. I therefore regard the carbon content as critical.

However, if a blade is to be used under unusually unfavorable abrasion conditions, quenching in oil will further add to the great toughness and resistance to abrasion of the blade.

Comparison tests with other ferrous alloys gave convincing proof of the superior quality of the alloy, permitting periods of operation exceeding 120 hours without the necessity of replacement of the blades. This has never before been attained.

Obviously the present invention can be employed with equal benefit in the production of machine parts subject to wear and abrasion other than proving blades. Such application of the invention manifestly is within the scope and spirit of this invention.

What is claimed is:

1. A blade adapted for use in centrifugal abrasive throwing wheels of the character including a rotor adapted to be driven at high speeds and carrying a plurality of substantially radially extending throwing surfaces with means for feeding abrasive into the inner ends of said surface, said blades having a propelling surface along which the abrasive may be gradually accelerated, the blades being formed from a metallic compound which is highly resistant to abrasive wear impact shocks and metal fatigue incident to prolonged operation in the throwing of steel grits, sand and similar abrasive particles at blasting velocities, said metallic compound including less than 1.5% by weight of carbon, between 0.50 and 0.90% by weight of silicon, between 0.50 and 0.90% by weight of manganese, between 0.90 and 1.40% by weight of chromium, between 1.40 and 1.90% by weight of molybdenum, and the remainder substantially pure iron.

2. A blade adapted for use in centrifugal abrasive throwing wheels of the character including a rotor adapted to be driven at high speeds and carrying a plurality of substantially radially extending throwing surfaces with means for feeding abrasive into the inner ends of said surfaces, said blades having a propelling surface along which the abrasive may be gradually accelerated, the blades being formed from a metallic compound which is highly resistant to abrasive wear impact shocks and metal fatigue incident to prolonged operation in the throwing of steel grits, sand and similar abrasive particles at blasting velocities, said metallic compound including approximately 1.20 to 1.35% by weight of carbon, approximately 0.60 to 0.80% by weight of silicon, approximately 0.60 to 0.80% by weight of manganese, approximately 1.00 to 1.30% by weight of chromium, approximately 1.50 to 1.80% by weight of molybdenum and the remainder substantially pure iron.

3. A blade adapted for use in centrifugal abrasive throwing wheels of the character including a rotor adapted to be driven at high speeds and carrying a plurality of substantially radially extending throwing surfaces with means for feeding abrasive into the inner ends of said surfaces, said blades having a propelling surface along which the abrasive may be gradually accelerated, the blades being formed from a metallic compound which is highly resistant to abrasive wear impact shocks and metal fatigue incident to prolonged operation in the throwing of steel grits, sand and similar abrasive particles at blasting velocities, said metallic compound including approximately 1.20 to 1.35% by weight of carbon, approximately 0.60 to 0.80% by weight of silicon, approximately 0.60 to 0.80% by weight of manganese, approximately 1.00 to 1.30% by weight of chromium, approximately 1.50 to 1.80% by weight of molybdenum and the remainder iron containing less than 0.05% by weight of phosphorus and less than 0.05% by weight of sulfur.

CHESTER E. UNGER.