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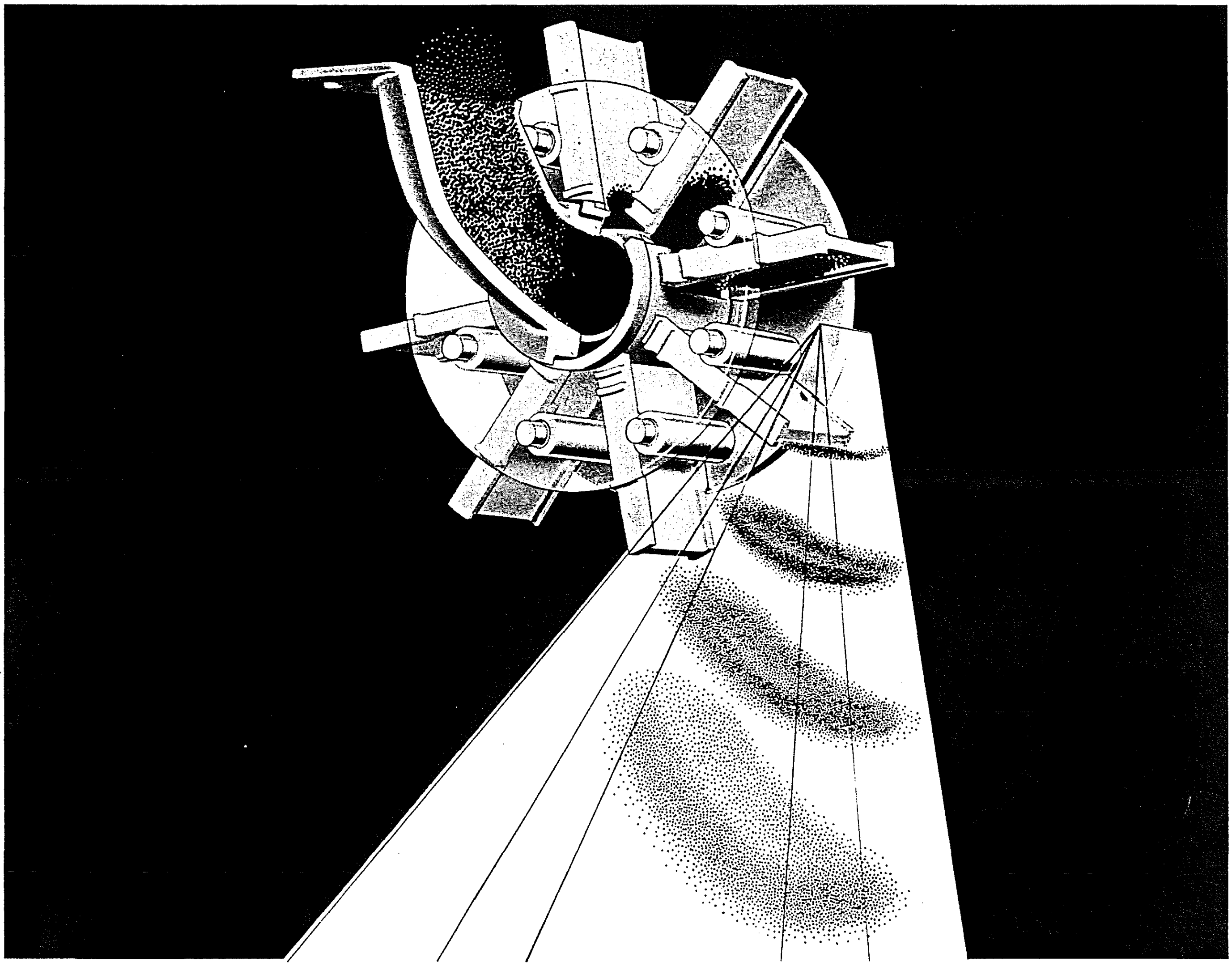


CENTRIFUGAL WHEEL PEENING

by John T. Pokorski

THE WHEELABRATOR CORPORATION

# CENTRIFUGAL WHEEL PEENING

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The utilization of a Centrifugal Wheel to propel media has been in existence for over 100 years. The development of a Centrifugal Wheel to propel media was predicated by the need to replace nozzle blast cleaning of components with a process that could increase productivity and decrease energy utilization. The Centrifugal Wheel met these requirements by permitting the flow of large volumes of media with significantly less energy usage. The utilization of Wheels with existing and new work handling methods achieved substantial output/productivity increases by either the elimination of a manual process or by the shear benefit of having the capability to propel large amounts of media to achieve cleaning quicker.

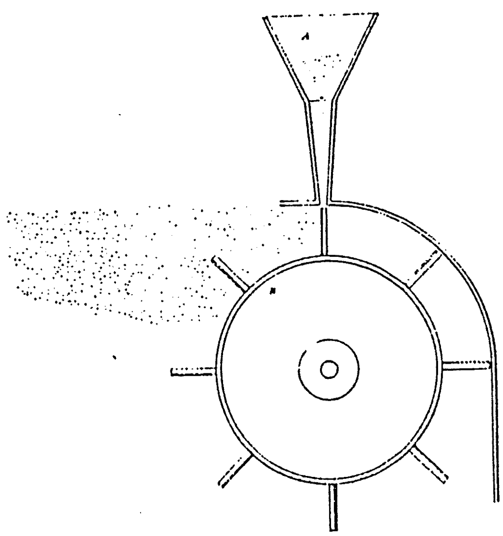
Coinciding with the development of the Wheel in the late 1930's and early 1940's were the preliminary benefits and knowledge of Shot Peening.

It is hard to establish the direct influence of the Peening Process and Wheel Development, but it appears to be evident that a controlled process would require significant gains in the targeting and control of the wheel blast pattern if the needs of industry were to be met.

The development of the process has been one of continued improvement from it's first inception. Progress in the development as in most cases has been dictated by the needs of industry or the desire of the inventor to develop a better method/process. The Wheel has continuously evolved to permit tighter control of the blast pattern it generates, the efficiency of it's operation, the control of performance variables and the basic causes and effects of the Wheel performance for industry.

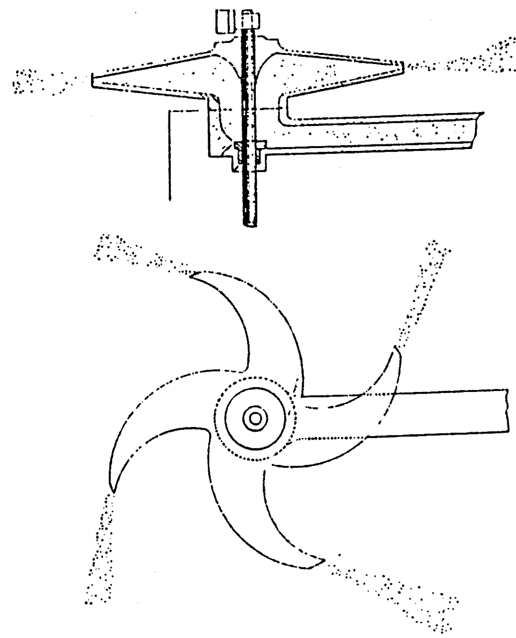
# DEVELOPMENT OF THE CENTRIFUGAL WHEEL

The first patents for Centrifugal Wheels were issued in 1870 to Mr. B.C. Tilghman. Mr. Tilghman patented both a "Batter" Wheel and the "Slider" Wheel (Figures 1 and 2)




*The original design by B. C. Tilghman produced in 1870 of what became known industrially as the "batter" type centrifugal blast unit.*

FIGURE 1



*A design in 1870 of a centrifugal blast throwing wheel by B. C. Tilghman. This may be classed as the original "slider" type wheel.*

FIGURE 2

These early Wheels utilized the principals of Centrifugal force to propel media, however the control and efficiency of the process provided only limited usage.

The next major development was a patent issued to E.L. W. Byrne (American Foundry Equipment Company) in 1936 for a blast wheel design that could be said to be the basis for all future designs. (Figure 3) The core fed wheel with directional control of the abrasive stream was now a reality. The principal value of the patent was in the directional control in which the abrasive was directed towards the work piece and not thrown indiscriminately from the Wheel.

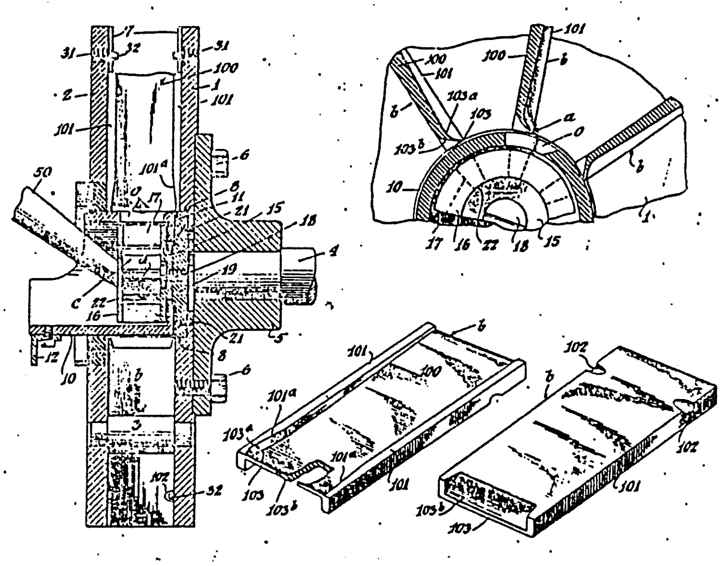
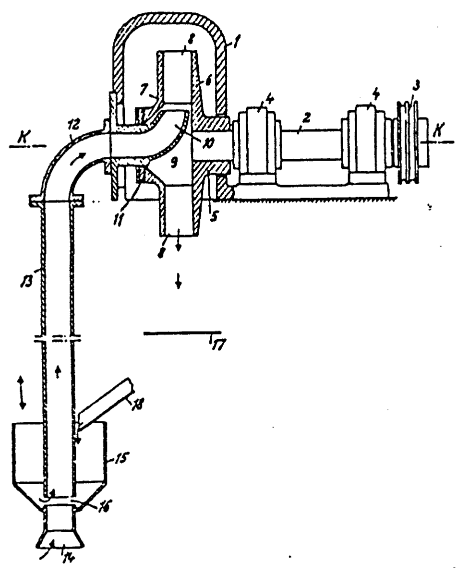


FIGURE 3

Various size and shapes of apertures, triangular, obliquely extended slot discharge and rectangular openings were utilized to effect the shape and size of the pattern. Replaceable throwing blades were also first used which permitted replacement of a high wear component.

In 1939 both The Society Anon Establissements a Sesson Lehmann and Alfred Gutmann Aktiengescelschaft fur Maschinenbau were granted patents for wheels that utilized either a fan or wheel suction to mix or assist the abrasive feed to the wheel. These inventions utilized an internal feed funnel to regulate abrasive flow. (Figure 4)



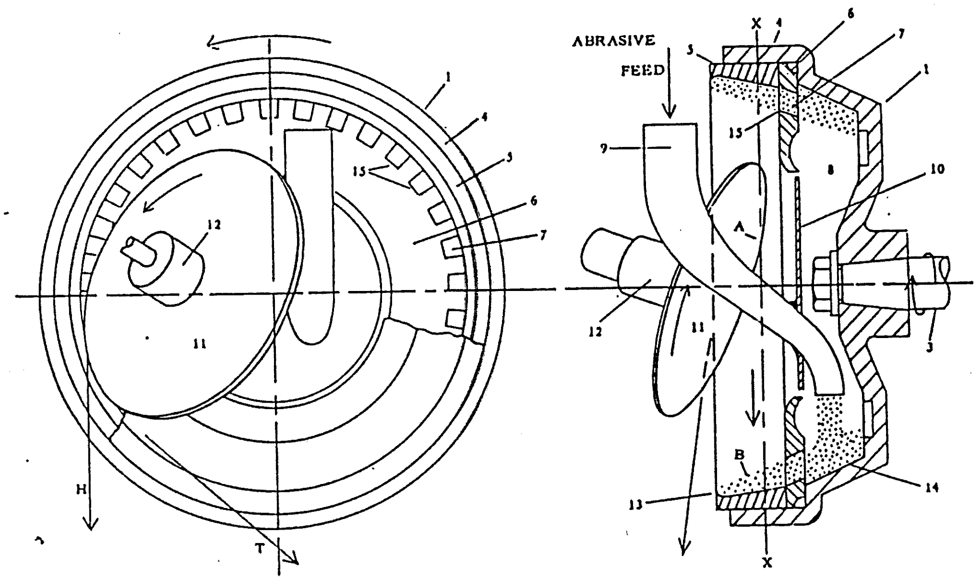

*Self-fed blast wheel. This design which was patented in 1939 took advantage of the inherent ability of the blast wheel to operate as a fan and thereby raise the abrasive independently of mechanical means.*

1. Wheel casing
2. Drive shaft
3. Grooved pulley
4. Bearings
5. Blast wheel
6. Driving side blast wheel
7. Inlet side blast wheel
8. Wheel blades
9. Blast wheel core
10. Feed pipe
11. Stuffing box or seal
12. Abrasive feed bend
13. Feed pipe
14. Nozzle providing injector action
15. Abrasive container
16. Abrasive/air mix
17. Turntable or support for work pieces
18. Abrasive feed chute

*Courtesy Alfred Gutmann Aktiengescelschaft für Maschinenbau.*

FIGURE 4

The Pangborn Corporation patented a Wheel in 1940 that had the primary objective to project the abrasive without the necessity to employ any throwing blades. (Figure 5)




Front and side elevation of a vaneless wheel

FIGURE 5

This design, however, did not reach the standards of effectiveness obtainable with bladed centrifugal wheels.

The same year Pangborn patented a Wheel produced of a single sided bladed wheel that is familiar today. The initial wheel utilized a scroll impeller to move abrasive to the control cage however, it was replaced in 1948, and patented with an impeller with "ribbed" configuration. This ribbed or tooth form was an improvement over the spiral.

In 1958 Tilghman Limited was granted a patent "for the highly technical process of shot peening" in the field of aircraft for peen-forming.

Since these early developments many patents have been issued based on blade shape, blade retention, reversibility of the wheel and other claims which provide greater control and efficiency of media flow through the wheel and therefore control of the process. Materials of construction have also changed from these early designs to permit greater life of components which translates to control of the process.

## EFFECTS OF WORN WHEEL COMPONENTS

When the Centrifugal Wheel is properly adjusted and the individual components of the Wheel are in good condition, the full effect of the media stream will be attained for maximum efficiency. The occurrence of longer than normal peening cycles, inadequate peening, and accelerated wear on cabinet interiors can usually be traced to either improper directional setting or loss or directional control of the media pattern.

The Media Pattern can be inspected by a procedure commonly referred to as "checking the hot-spot" blast. The metal target will become hot when subjected to a blast of 30 seconds or longer. (Figure 6)

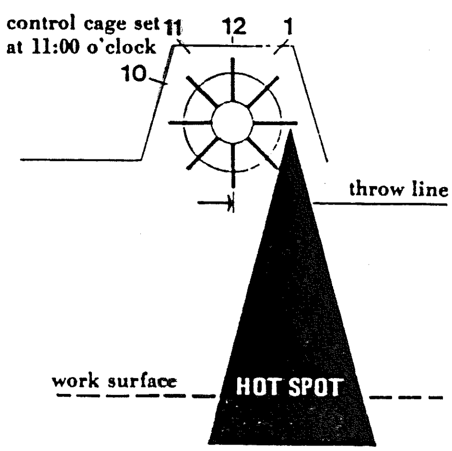



Fig. 6. Control cage setting adjusts the hot spot.

FIGURE 6

The heat can readily be felt in the area where the media is impacting the target most heavily. The target plate will also show visibly the area over which the blast has effectively impacted the surface.

In peening applications it is recommended that a series of almen blocks and almen strips be utilized to determine proper placement of the media stream. (Figure 7)

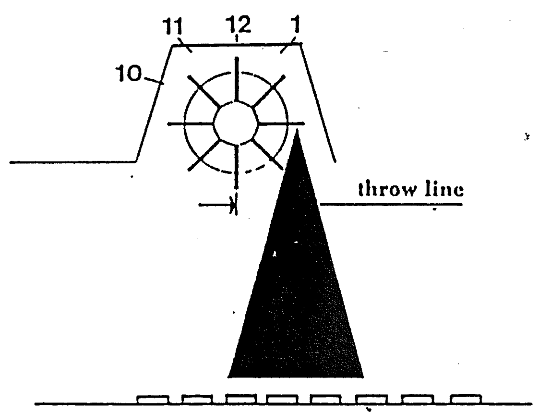
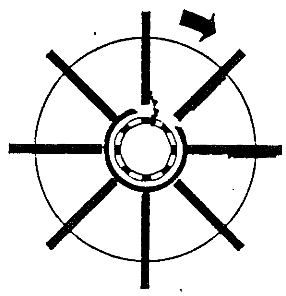


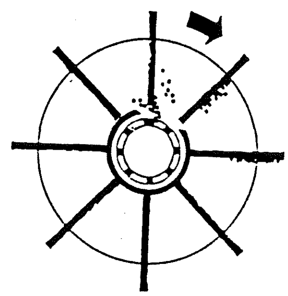

FIGURE 7

By utilizing the readings from the almen strips, you can adjust the location of the control cage to adjust the blast pattern to the desired location.

The principal causes of changes in the blast pattern are the wear on the wheel parts that control the direction and length of the pattern, the impeller, control cage and blades. These parts must be inspected regularly and replaced as soon as excessive wear or malfunction is detected. (Figure 8)



Impeller leads blades.



Impeller worn — no lead can cause an unbalanced wheel.

FIGURE 8

Wear on the impeller vanes and control cage spreads out (lengthens) the blast pattern and moves and cools off the "hot spot". Media leaving the worn vanes of the impeller will hit the back edges of the blades and land high on the face of the following blades rather than on the inner ends or proper spot on the blade focus. Wear on the control cage opening alters the location of the "hot spot" because media is thrown. The "hot spot" becomes badly diffused, resulting in a loss in media velocity and impact force.

Badly worn or pitted blades offer resistance to media flow along the blade face. As a result, the "hot spot" shifts and the total pattern may be lengthened, as media velocity is decreased.

# WHEEL OR NOZZLE/AIRBLAST PEENING?

Both Centrifugal Wheel Peening and Nozzle/Airblast Peening are utilized extensively in the industry. Both peening methods have the ability to provide controlled, repeatable and monitored processing of components.

Their are however, advantages to each system. The following are just a few of the advantages of each:

## Centrifugal Wheel Peening

1. Elimination of air compressors, their maintenance costs and cost of all auxiliary equipment such as drive, wiring, piping, controls, safety devices, air receivers, and after coolers.

2. Centrifugal Wheel Peening requires less horsepower to provide equal media flow.

3. Centrifugal Peening usually requires less floor space.

4. Centrifugal Peening eliminates incidental losses such as air leaks in pipes, valves, etc. which in many plants can amount to substantial losses.

5. Absence of moisture trouble, which in compressed air equipment, is one of the most annoying causes of delays and shut-downs.

6. Greater productivity due to the ability to cover greater areas.

7. Higher Velocities which equates to arc height.

## Nozzle/Airblast Peening

1. The Major advantage is the ability to utilize many varied medias without an accelerated breakdown of media by the process. Media's such as glass beads and ceramics can be utilized without excessive media breakdown.

2. Ability to peen bores and holes.

3. Ability to peen localized areas.

4. Ability to easily and precisely move the nozzle to peen specific areas or parts without part movement.

# CONCLUSION

The design of the Centrifugal Wheel, to propel media, has continuously evolved from its original inception in 1870. Development of the Wheel has been driven by industry demands and the desires for product differentiation

Future developments will continue to be influenced by a need for a competitive edge through efficient and cost beneficial design requirements. A continued joint effort will continue to keep the Wheel evolving with benefits to be shared by all.

## REFERENCES

1. William A. Rosenberger, Impact Cleaning, 1939.

2. H.J. Plaster, Blast Cleaning and Allied Processes, Volume I, 1972.

3. The Wheelabrator Corporation, Manual of Shot Peening Technology, 1977.

4. A.W. Mallory, Guidelines for Centrifugal Blast Cleaning, SSPC Publication "Shop Cleaning and Painting of Steel, Pages 5-17.