Shot Blasting Systems

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In recent years, shot blast cleaning systems have replaced other mechanical or chemical metal surface preparation processes. This is especially true where specifications call for cleaning, descaling, paint removal, deburring, coating surface preparation or achieving certain cosmetic goals.

Some of the processes replaced by shot blasting include wire brushing or grinding the surface manually, manual or automatic sanding, chemical dip tanks, and chemical etching systems. Shot blast systems have been successful in these applications because of the speed at which the tasks are completed, with minimal manpower requirements. In general, shot blast systems are much less expensive to operate than alternate methods.

Shot blast systems also have a high degree of repeatability, which is very important to manufacturers whose products require a consistent appearance.

In addition to cleaning or preparing the surface for a subsequent process, shot blast systems are also used to prolong the fatigue life of metals. Shot peening is becoming increasingly more important to automotive and aerospace manufacturers, since the thrust to lighten vehicles means lighter, more compact components must be used. These smaller components must meet or exceed the strength and performance expectations of their heavier counterparts. Shot peening as a final manufacturing process assures the design criteria are met.

Once a decision is made to replace an existing process with either shot blast cleaning or peening, the next step is selecting the equipment that will most effectively and efficiently achieve the desired results.

Most blast equipment manufacturers employ application engineers to augment their technical sales staff. These people first review your process specification in terms of task technicality and production rates. After this review, a determination is made on the physical characteristics of the equipment offered to satisfy your requirements.

There are two basic methods of accelerating the abrasive media to perform the work; compressed air or an airless centrifugal wheel device. Frequently, either method may do the job but one might be more efficient and cost effective! As you read through this analysis of the available equipment, you will better understand the challenges faced when trying to choose the best method or system for the job. From the simplest to the most complex, there's certainly something to satisfy your needs.

Airblast

To start this trip, let's first review Airblast equipment. There are three basic airblast systems: suction; gravity; and direct pressure.

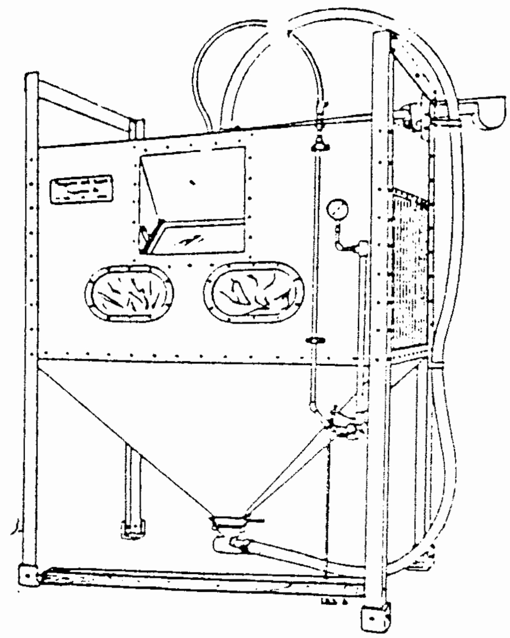
In the *suction system*, the compressed air is directed by an air jet into the nozzle to create a low pressure, high velocity air flow in the suction line leading to the gun. This line pneumatically conveys the abrasive from an abrasive collecting hopper to the blast gun, where it merges with the high velocity air streams. The spent abrasive drops into a collecting hopper where it is picked up by the suction line and recirculated through the blast gun.

The *gravity feed system* uses an abrasive gun similar to the suction gun, but the abrasive is fed to the gun by gravity from an overhead hopper. This eliminates the less efficient pneumatic conveyance of the suction system and replaces it with a more efficient abrasive metering feed. The major problem of the gravity system in comparison with the suction system (and the reason for its infrequent use) is the requirement of an abrasive elevating system to return the spent abrasive from the collecting hopper to the gun feed hopper for recirculation.

In the *direct pressure system* the abrasive is under pressure in a pressure vessel and is metered into the compressed air line to the blast nozzle. This system also requires some type of elevating system for abrasive recirculation. This is the most efficient system in terms of C.F.M. of air required per pound of abrasive moved and also produces the highest abrasive velocities and intensities. It is the only system which can move abrasive through long lances and side shooting nozzles to effectively clean or peen deep holes.

Airblast equipment is most versatile when used for selective cleaning/peening, deep cavity cleaning/peening, and low production work with small parts. Airblast produces a small round blast pattern with uniform angle of impact and abrasive distribution. This is an advantage over wheel equipment in that it allows much more selective targeting of the blast stream. On large complicated parts, however, multiple set-ups are usually required and blasting large areas becomes difficult.

In all airblast systems, abrasive velocity is varied by varying the air pressure to the nozzle.



(Fig. 1) *Suction airblast cabinet*

Suction Airblast Cabinets

Many different sizes of airblast cabinets are available. All of them operate the same way with the basic difference being size.

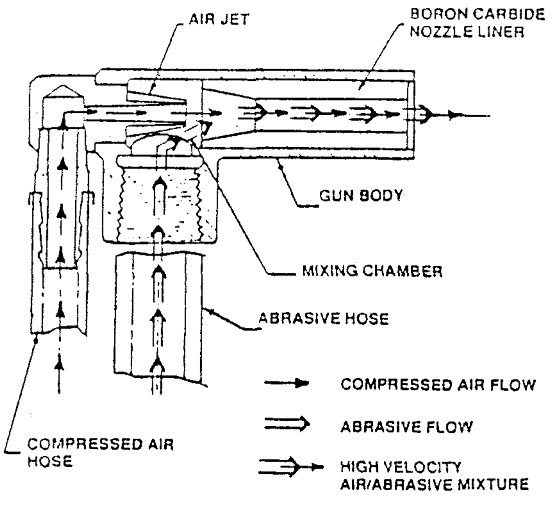
The cabinet (Fig. 1) is simple to operate, requiring no experience or special mechanical skill. Through spring balanced doors hinged at either end, the work is placed inside the cabinet and the doors closed. The operator turns on an air valve, and extends his arms into long-sleeved rubber gloves inside the cabinet. Holding the free-swinging nozzle, he directs it toward the work. With the foot treadle, he introduces the blast stream, aiming it at the areas to be cleaned. The whole operation is visible through a wide angle window of double thick glass, protected from flying abrasive by a fine mesh wire screen. The cabinet interior is lighted by large electric fixtures hung from the ceiling.

When the operator has cleaned a piece, he stops the blast stream by releasing the foot treadle, pushes the piece aside, and places another piece in position for cleaning. When the entire load is cleaned, the doors are opened and a new load moved in.

No special care of the cabinet is required and down time is reduced to a minimum. Occasionally the perforated floor of the cabinet should be removed for disposal of any coarse refuse from the cleaning operation. The floor is perforated so spent abrasive can drop through for reuse. Periodically, the abrasive requires removal. There are no moving parts to get out of order, no intricate mechanisms to be adjusted.

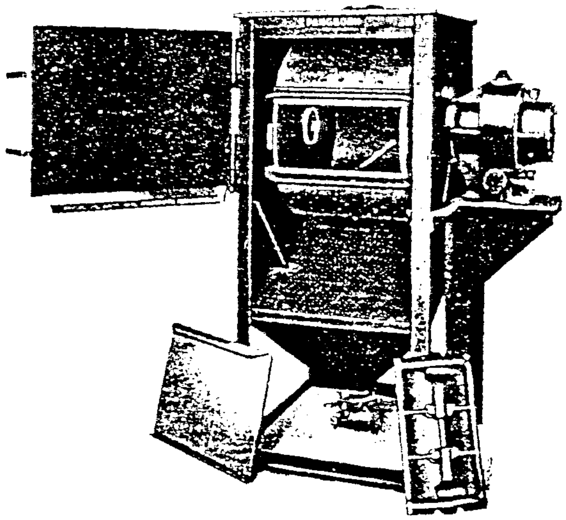
Abrasive – metallic, sand, etc. – is contained in a hopper at the bottom of the cabinet. It is thrown on the work by means of suction fed gun (Fig. 2). This discharge nozzle, in free position, is in the center of the sight opening, in convenient position for the operator's use.

When the worn abrasive is removed, the whole bottom assembly detaches allowing quick, easy gravity discharge. New abrasive is poured into the hopper from the cabinet floor level. It's only necessary to have a small quantity of abrasive (as little as a shovel full) in the hopper to operate a suction cabinet.



(Fig. 2) *Suction airblast gun operation*

Compressed air consumption of the cabinet is governed by the size of the air jet opening and pressure used. The air jets are generally 5/32" (for 3/8" diameter nozzle) or 7/32" (for 1/2" diameter nozzle); the larger, the faster the work. At 80 pounds of pressure, the 5/32" takes 33.2 cubic feet of air per minute; the 7/32":, 65 cubic feet, and correspondingly less at lower pressures. Discharge nozzle diameters are approximately twice the size of the air jet diameters. Abrasive flow to the nozzle is controlled by positioning the end of the abrasive hose, which is cut on a 45 degree angle, into the side of the abrasive pile in the feed box. Proper positioning insures the correct air/abrasive mixture is obtained for continuous uniform flow.



(Fig. 3) *Airblast barrel*

Airblast Barrel

Another type of suction blast machine is the Airblast Barrel (Fig. 3), with an abrasive system almost identical to that of the airblast cabinet. A suction nozzle is mounted at one end of a rotating drum and targeted into the work load as it tumbles. Abrasive and refuse from the work fall through perforations in the barrel and into a screen which removes the large particles. The abrasive then passes into the hopper above the feed box eliminating the possibility of large particles re-entering the abrasive system. The barrel drum is made of heavy steel plate welded into a shell, and an easily removable wear plate protects the drum head from the impact of rebounding abrasive.

Non-ferrous foundries use this barrel on small castings which can be tumbled without damage, especially when blasting with sand, aluminum oxide or some other non-metallic abrasive. It is also used for general purpose cleaning of small parts, usually using non-metallic abrasives, although metallic abrasive can be used.

The airblast barrel is compact and rugged, with low initial cost and maintenance. Individual work pieces shouldn't be larger than those which will roll freely in every direction. Operating pressures are as low as 20 PSI. The barrel has a direct motor drive.

The average time for cleaning typical work loads in an airblast barrel will seldom exceed 15 or 20 minutes.

Hydrofinish®

This is Pangborn's name for a modified form of impact blasting using an abrasive suspended in a liquid slurry which is delivered to the blasting nozzle by suction.

Since the abrasive particles are suspended in a liquid, there is no limit to the fineness of the particle which may be used. The carrying media most used is water, with inhibitors added to retard corrosion.

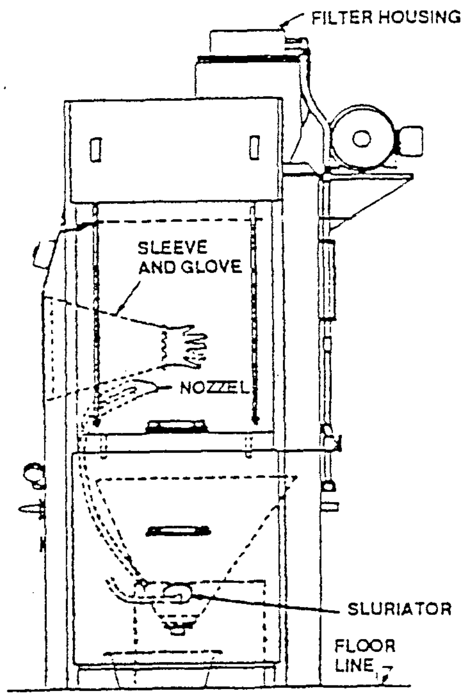
Hydrofinish is used in operations where the depth of abrasive, etch and stock removal requirement is minimal. Some of the more common uses are:

- Deburring
- Surface finishing and lubrication control
- Removing heat treat scale, discoloration and other surface cleaning
- Preparing surface for electroplating and other coatings
- Removing and blending directional grinding lines
- Finishing threaded sections for workability and fit
- Improving cutting tool life and appearance
- Die and mold maintenance
- General maintenance cleaning

It's important to note this type of blast can hold tolerances of .0001 inch on some materials.

Hydrofinish is accomplished in a watertight cabinet (Fig. 4) provided with a hopper tank for mixing, storing and collecting the suspension. Sluriators consisting of air jets are located at the sides of the hopper near the bottom. The position and angle of these sluriators not only provides rapid agitation of the slurry, but also does it evenly without boring a vertical hole, up through the settled abrasive. A needlepoint valve enables the operator to control the degree of agitation by regulating the air pressure to the sluriators using a knee operated valve.

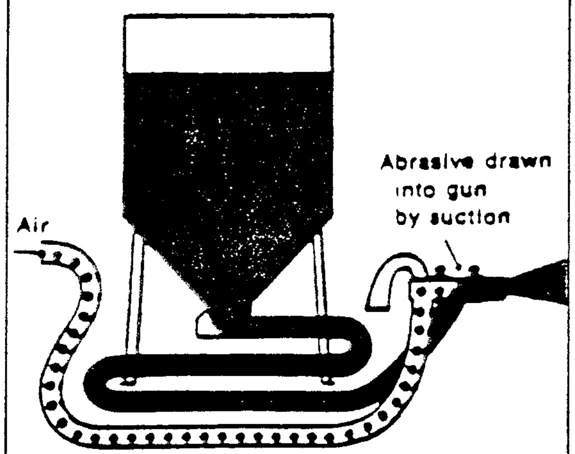
The operator works through hand holes located at the front of the cabinet similar to the operation of the suction airblast cabinet discussed earlier. The work is supported by a perforated floor in the cabinet or the cabinet can be equipped with accessory track and loading



(Fig. 4) *Hydrofinish cabinet*

car with bearing mounted turntable. The size of the work is regulated by cabinet dimensions.

The used abrasive is passed through a fine mesh screen, which retains large debris such as the burrs in a deburring operation. The abrasive is then dropped into the agitating slurry for reuse. The screen is periodically cleaned and the residue removed.



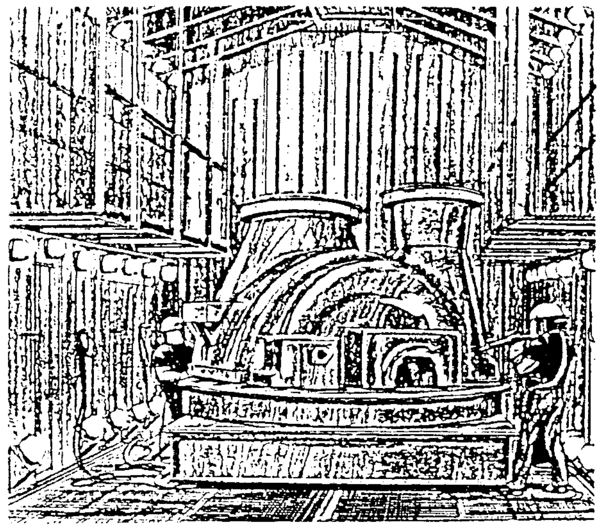
(Fig. 5) *Suction airblast tank*

Suction Airblast Tank

This 2.2 cubic foot unpressurized blast tank (Fig. 5) is inexpensive and readily portable. It incorporates a suction type blast gun and is used in applications where the intense action of direct pressure is not required.

Direct Pressure Airblast Equipment

Direct pressure airblast is a versatile method for generating a controlled, high intensity flow of blast media. There are many applications for direct airblast equipment and there are many airblast rooms (Fig. 6) and blast tanks in operation today. They are cleaning castings, forgings, weldments for maintenance cleaning, electrical equipment, locomotives, large transformer castings, peening, structural descaling, plates, rods, wire, die cleaning, me-



(Fig. 6) *Large airblast room*

morial art, building and wall cleaning, storage tanks, bridges, etching, forming, cleaning alloy castings, antiquing, wood paneling, plus a host of other cleaning and surface preparation applications.

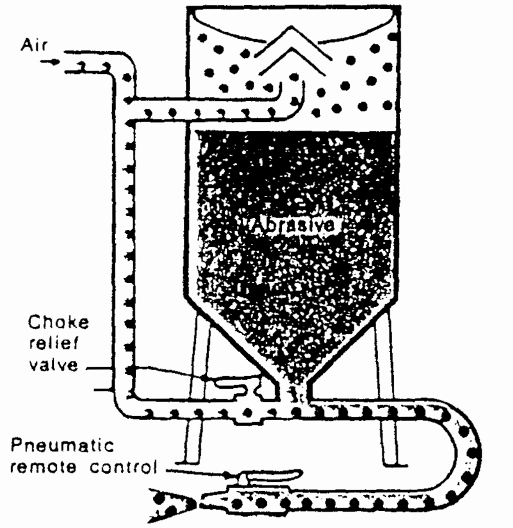
Many special machines using direct pressure are furnished using one or multiple nozzles. When four or more nozzles are installed in a cabinet, a distributing pot or abrasive manifold handling system must be installed.

Direct pressure is sometimes needed for certain blast cleaning or peening operations where a suction gun won't provide the necessary impact. Direct pressure gives considerably more impact than a suction gun. This impact comparison for small shot can indicate 50% more arc height on an Alman "A" strip.

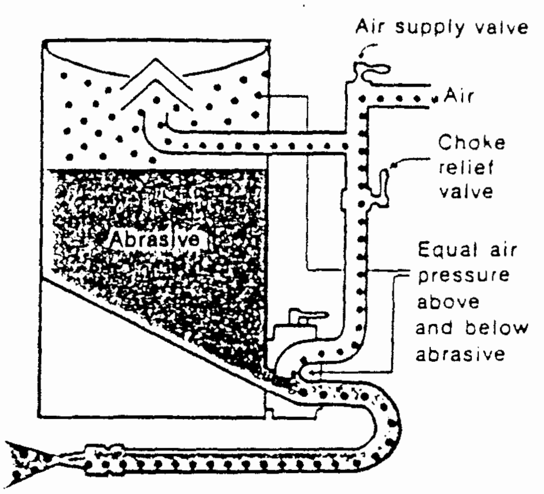
Most direct pressure blasting is done at 80 PSI. On test work, approximately 55 PSI with direct pressure and 60 PSI with suction gun is used to simulate a centrifugal wheel with metal abrasives. Within certain sizes of metal abrasive, the smaller the abrasive, the higher the impact using the same pressure.

Direct Pressure Tanks

The direct pressure tank, which is the heart of any piece of direct pressure airblast equipment, can be used with some type of enclosure



(Fig. 7) *Intermittent direct pressure tank*



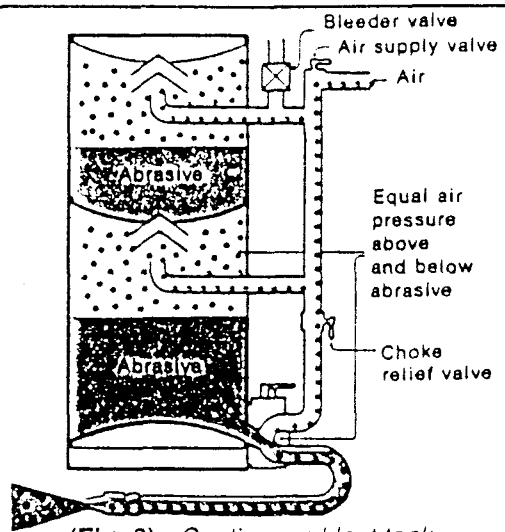
(Fig. 8) *Non-venting intermittent tank*

such as a cabinet or room or separately. As a separate unit, it's often used for on-site blasting out-of-doors . . . for rust removal on water tanks and bridges, cleaning buildings and ship hulls, and memorial art. Used with enclosures with abrasive reclamation systems, it serves as an efficient airblast system for general cleaning, shot peening, or deburring. Direct pressure tanks are available in both dry and wet blast models, using all types of abrasive media. Several different models can be supplied with either single or multiple nozzles, for stationary, portable, intermittent or continuous operation.

Intermittent direct pressure tanks (Fig. 7) are versatile, low cost units available in portable models. One important option available is all pneumatic remote control by the operator at the nozzle. Some intermittent tanks are pressure venting. When the nozzle remote control is released, the air in the tank immediately exhausts. This allows the filler valve to open automatically, recharging abrasive into the tank from the supply hopper. Turning the blast control on immediately resumes blast action, with full pressure reached in about five seconds. This type of intermittent tank is best used on medium or large work requiring 13 to 14 minutes of steady blast. It's not recommended where the work requires frequent starting and stopping of the blast action.

Non-venting Intermittent Tanks (Fig. 8) are heavy duty units built for stationary or portable production demands. These tanks are pressure holding, permitting start and stop of the blast action without loss of tank pressure. When ready to blast clean, a regulator on the mixing chamber enables the operator to control flow of abrasive to suit the nozzle being used or type of work being cleaned. This control remains constant until changed by the operator. After pushing the air valve push rod on the blast tank, the unit starts pressurizing and the abrasive filling valve at the top automatically closes. To commence blasting, the operator presses the lever on the safety control (deadman control) located at the blast nozzle. This stops the flow of low pressure at the handle, builds up the pressure to open the normally closed valve at the bottom of the air engine and closes the normally open valve at the top. This raises the air engine piston, equalizing the pressure above and below the abrasive. The abrasive from the blast tank is now allowed to flow by gravity through the mixing chamber, where it's mixed with the compressed air from the air line. It then passes to the blast nozzle, where the blast action takes place and the work is cleaned.

As soon as the operator releases the pressure on the remote control handle, the pressure valve reverses, which lowers the engine



(Fig. 9) *Continuous blast tank*

piston. This shuts off the air and abrasive to the mixing chamber, stopping the blast action.

To refill the blast tank with abrasive, the operator must pull the air control valve push rod, opening the air control valve, which shuts off the air to the blast tank. This opens the exhaust valve, depressurizing the blast tank. When the tank is depressurized, the filling valve at the top automatically opens, allowing abrasive refilling.

Non-venting intermittent tanks are recommended for cleaning of large castings, weldments, etc., where it's desirable for the operator to start and stop the blast action frequently. It's also used where the total blast cycle time does not exceed the supply time capability of the tank.

The other main type of blast tank is the continuous direct pressure style. Designed for operations with large regular production, continuous blast tanks (Fig. 9) operate on the multiple airlock principle using two compartments. The compartment is always pressurized, allowing abrasive to flow by gravity to the mixing chamber or chambers. The upper compartment is alternately pressurized and normalized by the use of a bleeder valve, controlled by an electrical timing device. The time cycle for this device ranges from one to six minutes, and is determined by the amount of abrasive that flows from the nozzle or nozzles.

In operation, the electrical timing device times out, opening the bleeder valve which exhausts the upper compartment. When the pressure in the upper compartment drops below the pressure in the lower compartment, the lower filling valve automatically closes, maintaining the pressure in the lower compartment. The upper filling valve automatically opens when the upper compartment is normalized, allowing the compartment to fill with abrasive from the storage bin. At the end of a predetermined time, the timing device closes the bleeder valve, allowing the upper compartment to pressurize, automatically closing the upper filling valve. When the air pressure in the upper compartment reaches the same pressure as the lower compartment, the lower filling valve automatically opens, allowing the abrasive to flow by gravity into the lower compartment and mixing chamber.

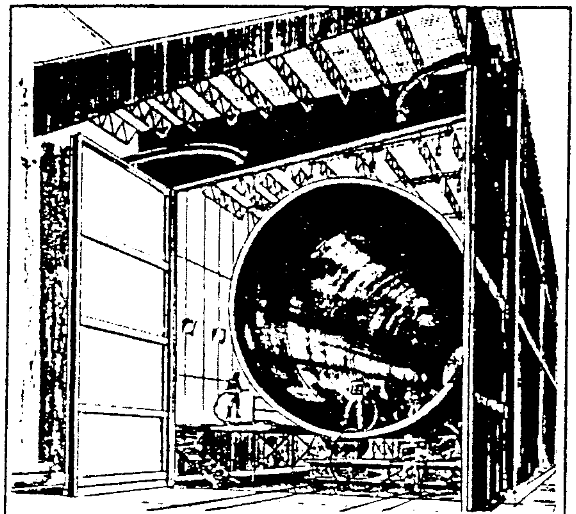
To start blasting, the operator presses the lever on the safety control handle (deadman control) located near the blast nozzle. This stops the flow of low pressure air at the handle which builds up pressure on a pressure valve, opening the normally closed valve at the bottom of the air engine, and closing the normally open valve at the top. This raises the air engine piston, allowing the abrasive to flow by gravity into the compressed air line to the nozzle or nozzles for blast action.

Blasting continues uninterrupted until the tank is either stopped by the operator or permanently, at day's end when the machine is shut down.

To stop the blast action, the operator releases the lever on the remote control handle, reversing the pressure valve which lowers the air engine piston. This cuts off the mixing chamber and stops the flow of air and abrasive to the blast nozzle.

Airblast Room

An airblast room (Fig. 10) is an airtight enclosure into which work pieces are placed and blasted by an operator or operators from inside. The modern airblast room system consists of a steel room structure, abrasive handling-reconditioning equipment, an airblast



(Fig. 10) *Modern airblast room*

tank machine with blast hose and nozzle (or several) and a work handling system. Good lighting, ventilation, dust control and operator convenience are provided. The operator must wear protective clothing, helmets, respirators, special gloves, leggings and rubber aprons.

Airblast rooms are furnished for a wide variety of blast cleaning, descaling, peening, surface finishing, deburring, and deflashing applications. They use metal abrasive, soft abrasive, aluminum oxide, sand and special abrasives that can be handled in a direct pressure tank.

While centrifugal wheel equipment has taken over many blast cleaning, shot peening and steel descaling jobs formally handled by airblast, certain types of work and/or production requirements still make the airblast method the best available choice.

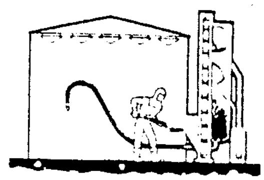
For example, you can target an abrasive airblast stream with pin-point accuracy. You can use sand or aluminum oxide as well as other abrasives.

Cost is always a factor – and sometimes airblast is clearly the lowest cost way to do the job.

In early years, users cleaned large castings, forgings, or other items by blasting them with sand out in the yard or in a blast room. With the introduction of metal abrasives, more companies went to rooms to take advantage of the efficiency and cost savings. Airblast rooms come in a wide variety of sizes and are used for cleaning locomotives, large transformers, railroad cars, weldments of all sizes, plates, structurals, large vessels, storage tank sections, boilers, and a variety of other products.

They also are supplied in various configurations to suit individual customer requirements and budgets. Four typical styles are the No-Pit, Floor Hopper, Standard Pit and Minimum Pit designs. Let's review these now.

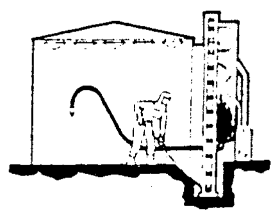
No-Pit Type



(Fig. 11) *No-Pit type room*

Semi-manual abrasive recovery is the distinguishing feature of the no-pit room (Fig. 11). Here the floor is solid concrete or wood block construction and level with the plant floor. Spent abrasive is recovered and returned to the system in two steps. The first step is manual. The operator sweep spent abrasive along the floor to a chute opening in the wall and shovels it through the opening where it drops to the floor-level elevator boot. The second step, through screening and the airwash separator, is automatic and identical to all other room types. This abrasive recovery method naturally takes operator time. But the low investment (no-pit or conveyor system) makes it a good choice for companies where cleaning requirements aren't sufficient to warrant investment in maximum production facilities.

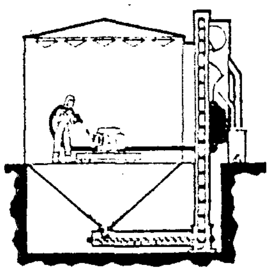
Floor Hopper



(Fig. 12) *Floor Hopper type room*

The floor hopper type abrasive recovery system is a variation of the no-pit type (Fig. 12). Here also, abrasive recovery is semi-manual. There is one major difference, however. Instead of shoveling the spent abrasive through a 28 inch high wall opening, a floor hopper arrangement allows the operator to sweep the abrasive though a 2' x 4' floor grating, where it drops by gravity to the elevator boot. A small pit is required to accommodate the floor hopper and position the abrasive elevator properly. Eliminating the need to lift abrasive to the chute opening saves operator time and is usually well worth the small extra investment.

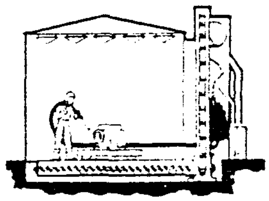
Standard Pit



(Fig. 13) *Standard Pit type room*

Automatic abrasive recovery for airblast rooms of all sizes is provided by standard pit design (Fig. 13). Spent abrasive from the blast process drops through the grated or perforated room floor into the hoppers below. From each hopper, a spiral conveyor system continuously moves the abrasive to the elevator boot where it is picked up for its trip through the abrasive reconditioning system. Since the entire abrasive cycle is automatic, the operator is able to spend full time on the blast cleaning job. This boosts cleaning production per man-hour and provides the ideal type of airblast installation for companies with larger production requirements.

Minimum Pit



(Fig. 14) *Minimum Pit type room*

The newest type of airblast room offers the same completely automatic abrasive recovery as the standard pit room, but the conveyor system is designed to fit in 18 to 24 inches of space below the floor. A minimum excavation can supply the space required for this shallow pit system. If preferred, the blast room can be raised about 18 inches above the plant floor level, so no pit construction is required. The minimum pit type room (Fig. 14) offers the perfect solution where production indicates automatic abrasives recovery is the logical choice, but standard pit excavation is impractical or undesirable.

Airblast room construction can vary with the type and size of the unit. In general, standard doors are usually hinged, but roll-up or sliding doors are often furnished. Swing doors are self-closing and self-sealing, and for smaller rooms, are manually operated. For large rooms, power swing or roll-up doors can be furnished. Power can be air cylinder or motor driven.

On small airblast rooms, the standard is 10 gauge steel for walls and ceilings up to a maximum of 20' high and 18' wide. The steel is formed into double edge flanged panels usually 5' in width and panels are bolted together using 1/2" bolts with sealing strips between.

Ceiling mounted D-2 electric light fixtures are furnished as standard. Also furnished are cone type air inlets to prevent escape of abrasive. Air outlet ducts are mounted on side wall for down-draft ventilation. Exhaust connections are supplied for connecting to existing ventilating piping.

The lower abrasive conveyors in airblast rooms are a screw conveyor with heavy cast or steel flights, or a steel ribbon conveyor flight. Oscillating conveyors are generally used where the length is over 16' to 18', as this is about the maximum for a screw conveyor without a center support.

With a deep pit, a full recovery system can be used, thus eliminating any lower abrasive conveyor. A gravity hopper room sells for less than the same size and type of shallower pit room with a conveyor. The maintenance is minimal for a gravity hopper design. In practice however, the customer must consider the cost of construction of the deeper pit and also other miscellaneous considerations such as rock and high water table problems.

For large airblast rooms, room structures are 3/16" plate or 10 gauge steel for sides and ceiling, with reinforcing where necessary.

On larger rooms the flange and bolted construction gives way to panel and beam construction, due to the reinforcing requirement. For rooms 25' high, reinforcing members are used every four feet on side panels and for 18' - 24' wide rooms. On rooms 24' - 30' in width, lateral beams at the middle of the reinforcing member are also used. In some cases, very large airblast rooms become more of a building than a room. Large sheets of rubber are hung in the lower areas to protect the thin gauge construction of the walls. Standard doors, air inlets and ventilation hoods can be incorporated into the galvanized design. Very large rooms usually have fixed or hinged operator platforms to allow blasting to take place several feet off the floor.

In recent years, manufacturers have attempted to market large airblast rooms from a components-only standpoint. That is, provide the engineering expertise and the below-the-floor abrasive recovery system. This system usually consists of the car track, floor grating, structural support steel, abrasive recovery hoppers, abrasive conveyors, elevator, separator, blast tank and operator accessories. For the above floor portion of the room, in addition to engineering drawings, they can supply items like the D-2 lights, mercury vapor lights, air inlet cones and work door hardware. Since customers of large airblast rooms are often steel fabricators, it's quite easy for them to fabricate the large steel plate portion of the room themselves.

Ventilation Requirements

Airblast rooms normally use longitudinal or down-draft ventilation.

For down-draft ventilation, air enters through the roof of the room and is exhausted continuously along the sidewalls near the floor. The CFM required is obtained by multiplying the room length by the room height by the desired lineal feet per minute. For example: in a room 30' wide by 40' long by 10' high, with 70 LFM desired, required CFM would be obtained by multiplying 40' by 10' by 70' equalling 84,000 CFM. While down-draft ventilation is probably the most advantageous type of ventilation to have in large airblast rooms, it is also quite expensive.

For economics, longitudinal ventilation is mostly used in airblast rooms. In this case, the room's width by height is multiplied by the recommended lineal feet per minute. In the example given above, horizontal ventilation would be obtained by multiplying 30' by 10' by 90' per minute for a required CFM of 27,000.

For additional operators, the required ventilation must be increased by approximately 20 percent.

Work Cars

Often special capacity work cars are furnished. These work cars are manually pushed in on wheels using either rails or the room floor. Cable pulling arrangements also can be used. A manually operated turntable is often put on the work car and driven by a power wheel installed in the room. The ultimate is a power drive for moving the work car into the room, with a separate power rotating table.

Blast cars can be furnished with or without rotating tables for operating in an automatic or manual mode.

Besides work cars, airblast rooms are sometimes equipped with a monorail beam using a chain fall or powered hoist. This monorail beam can either be installed inside the room, reducing the overall head room available, or it can incorporate a slot in the ceiling for a hoist to be lowered from outside the room. When split construction is required, the price of the airblast room is drastically increased, due to the large additional amount of support steel which becomes necessary.

Centrifugal Wheels

As we said earlier, blast cleaning is a process where abrasive particles are propelled at high velocity to impact the surface to be cleaned and forcefully remove surface contaminants. This process is often used to provide a uniform cosmetic finish or etched surface in addition to merely cleaning the work piece. Shot blast systems are also used to improve metal fatigue life through peening.

Centrifugal wheels are the most widely used method because of their ability to propel large volumes of abrasive efficiently.

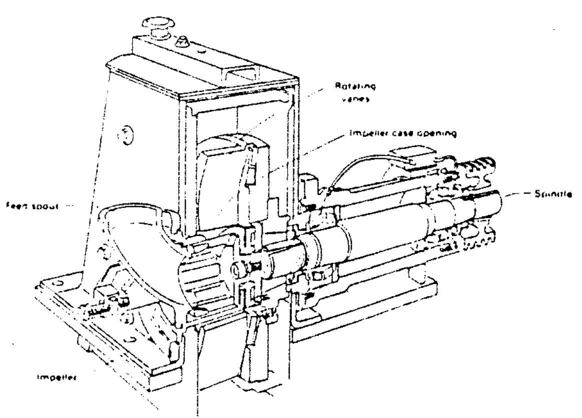
For example, a 75 hp centrifugal wheel can accelerate steel shot to 240 feet per second at 123,000 pounds per minute flow. To do the same with 1/2" diameter nozzles would require 20 nozzles and an air compressor driven by a 940 hp electric motor. It's obvious from an energy viewpoint, a centrifugal wheel machine should be used whenever possible.

There are a number of components that are common to every shot blast system utilizing a centrifugal wheel. How we present the work to the abrasive stream will determine the type of material handling system to be used and most often the work piece itself determines the configuration of the cabinet.

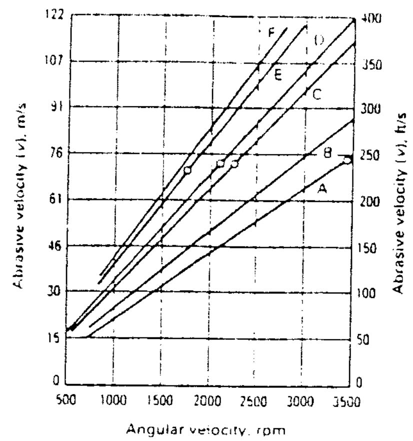
Every centrifugal shot blast wheel machine has these components:

1. One or more centrifugal wheels
2. Work handling system
3. Abrasive handling system
4. Abrasive containment (cabinet)
5. Dust collector

First, centrifugal wheels (Fig. 15) are available in diameters ranging from 10" to 25". There are a number of differently shaped blades or vanes used, depending on the work being cleaned. Most wheels incorporate an impeller and impeller case to feed the abrasive media onto the heel of the vanes. The abrasive stream can be targeted by simply rotating the impeller case.



(**Fig. 15**) *Cutaway view of curved vane wheel*



(**Fig. 16**) *Plot of abrasive velocity versus angular velocity for both straight vane and curved vane centrifugal wheels*

There are five factors that affect cleaning rates by centrifugal wheels:

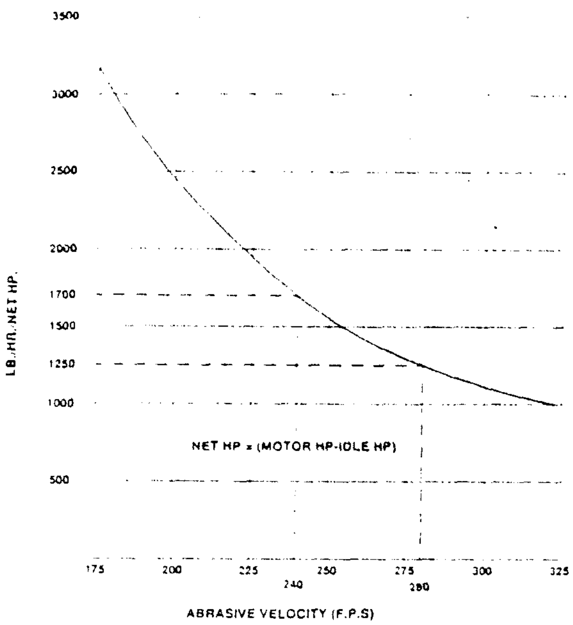
- Abrasive velocity
- Abrasive flow rate
- Abrasive distribution
- Angle of impact to the work
- Size, shape and hardness of the abrasive.

Any abrasive velocity can be achieved by sizing the diameter of the wheel and the RPM of the wheel. Figure 16 compares the angular velocity of the wheel with the resultant abrasive velocity.

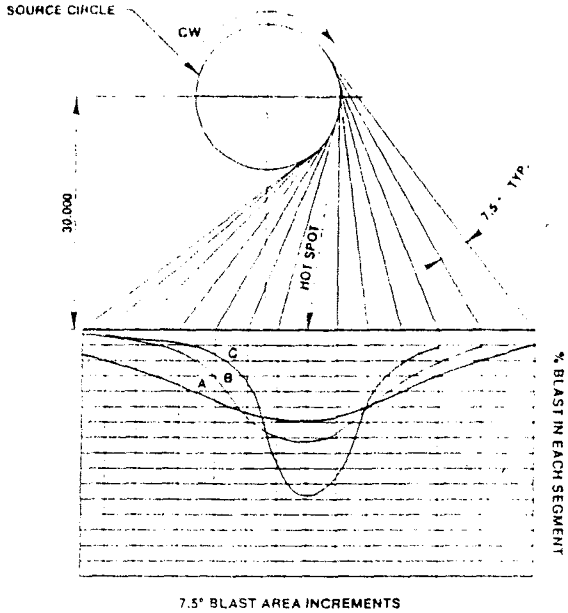
Abrasive flow rate is important to the cleaning process because it is abrasive particles impacting the work piece that performs the cleaning. More impact equals faster cleaning. The total horsepower required depends on the optimum abrasive velocity to be used and the number of pounds of abrasive per hour needed to cover the work being cleaned. Standard speed wheels can flow 1,700 pounds of abrasive per horsepower per hour.

We have included a graph (Fig. 17) showing abrasive flow rates compared to abrasive velocity.

There are a number of methods used to achieve proper abrasive distribution for a specific application. The first is simply choosing the wheel diameter that comes closest to producing the optimum abrasive stream. The abra-



(Fig. 17) *Effect of abrasive velocity on abrasive flow/hr.*

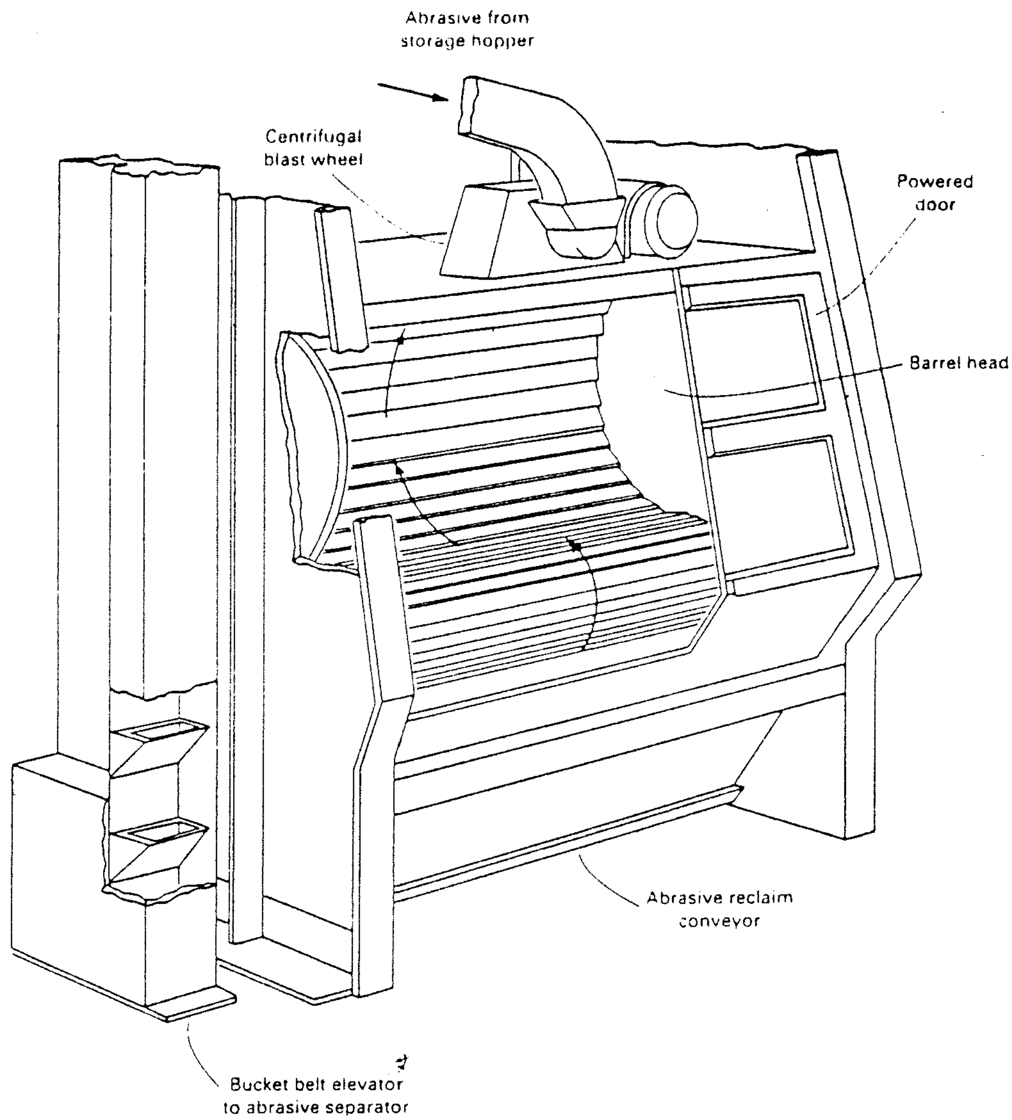


(Fig. 18) *Abrasive distribution in three typical wheel patterns*

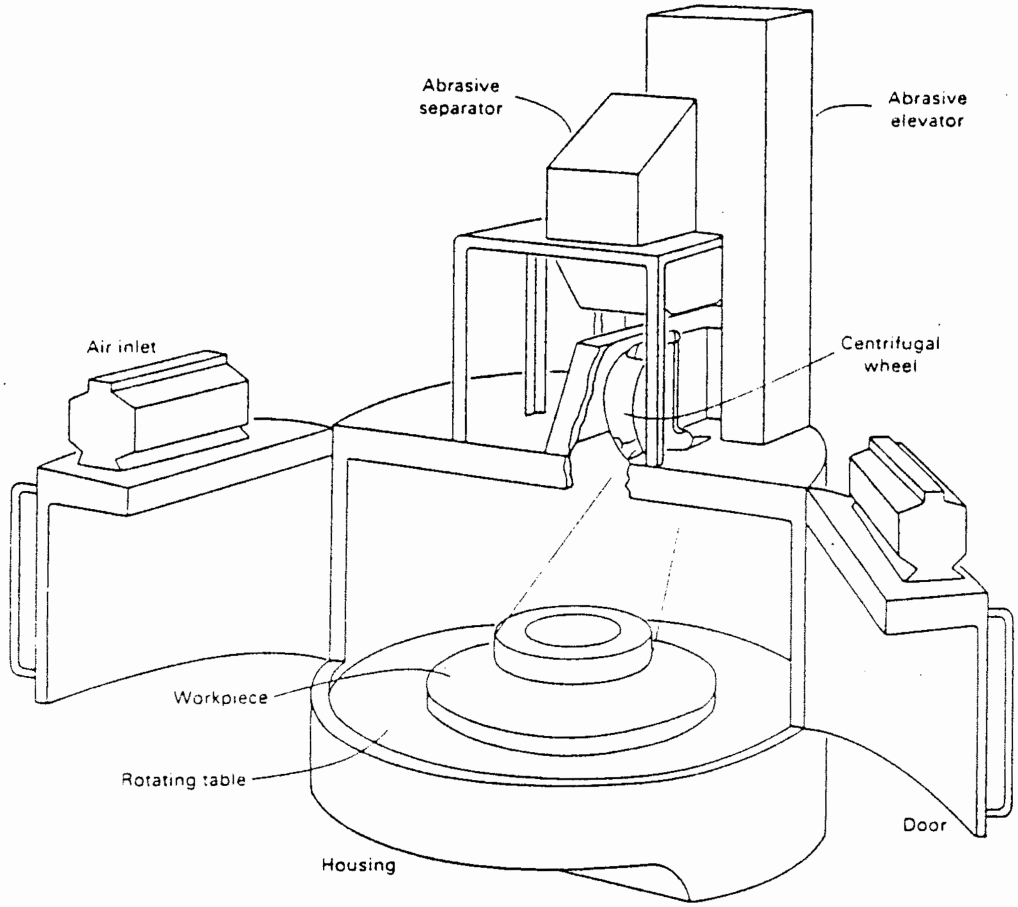
sive stream can then be refined to satisfy the requirements through the use of special impeller case openings. This refinement takes place since each blast pattern is uniquely distributed and can vary with impeller case openings as shown on Figure 18. Here we illustrate three typical wheel patterns with the percentage of abrasive distribution in each 7 1/2 degree segment. The short pattern (c) obviously has more abrasive in the "hot spot" area, where the most cleaning takes place.

Second, the work handling systems simply deliver the work pieces to the abrasive stream and carry the pieces to the next operation after cleaning is completed.

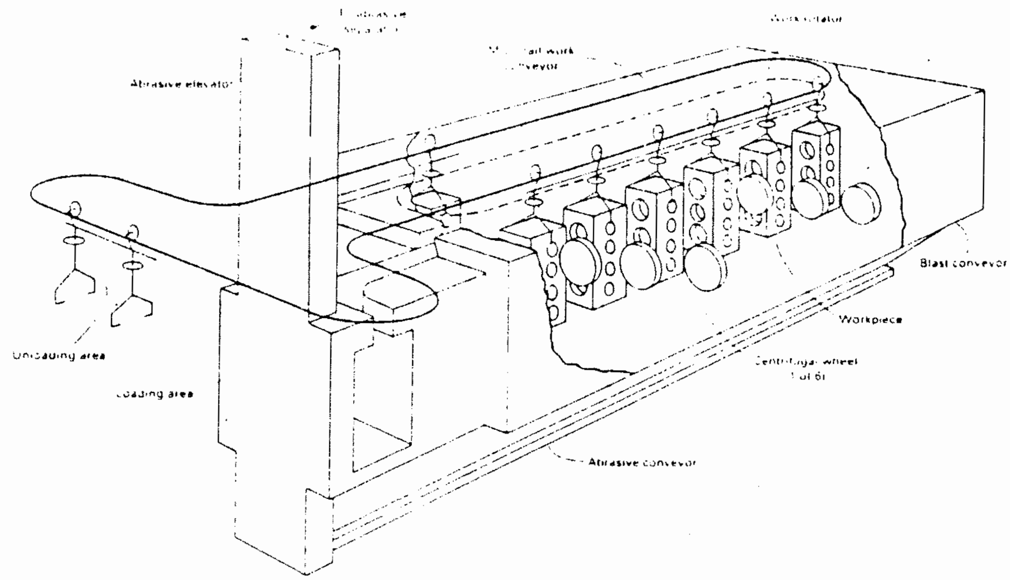
The illustrations (Fig.'s 19 - 22) graphically depict typical work handling systems supplied with shot blast equipment.



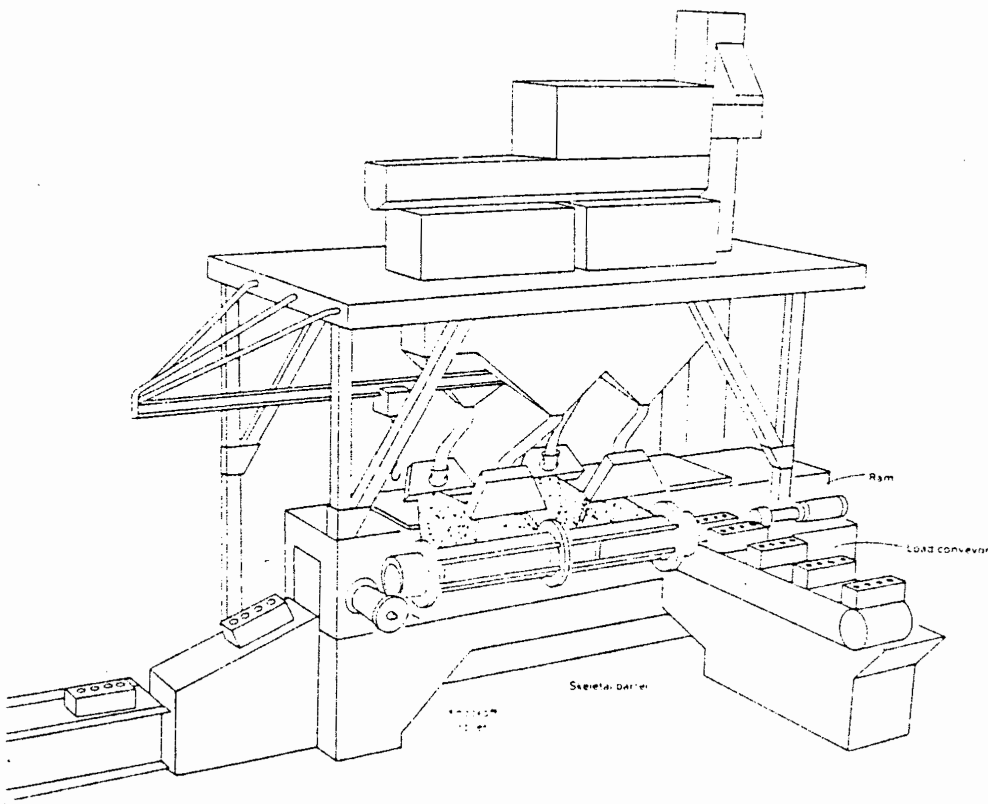
(Fig. 19) *Batch-tumbling barrel*



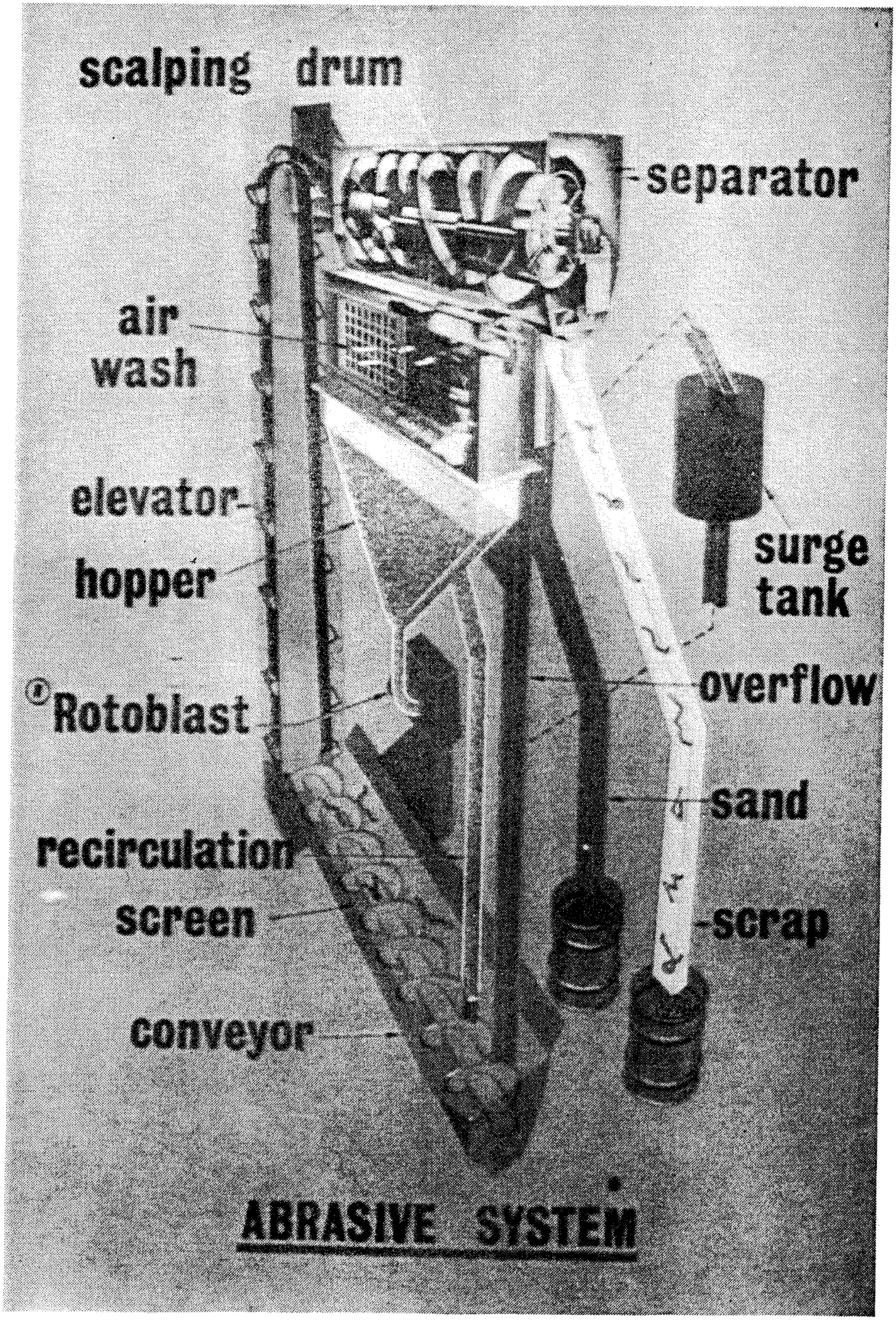
(Fig. 20) *Table type machine*



(Fig. 21) *Continuous monorail machine*



(Fig. 22) *Axial-flow machine for engine heads*


scalping drum
separator
air wash
elevator
hopper
surge tank
®Rotoblast
overflow
sand
recirculation
screen
scrap
conveyor
ABRASIVE SYSTEM

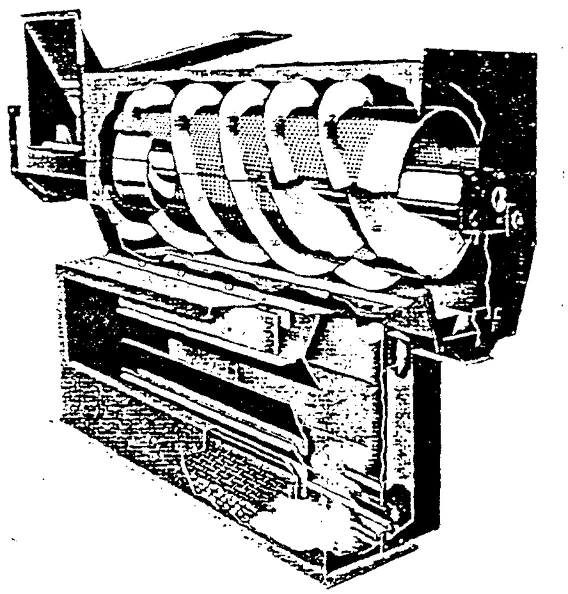
Third, a typical abrasive handling system (Fig. 23) includes a screw conveyor that will deliver abrasive thrown by the centrifugal wheel to a bucket elevator. The bucket elevator lifts the contaminated abrasive and deposits the mixture into a rotary scalping drum. The scalping drum removes coarse foreign material from the abrasive mixture.

The abrasive mix in transported by gravity to the airwash separator.

The airwash separator (Fig. 24) is probably the most important component in the entire shot blast system. It removes dust, spent fines, mill scale, paint chips and other contaminants to insure only clean, usable abrasive is returned to the storage bin to be fed to the centrifugal wheels. Contaminated abrasive will not clean efficiently. The airwash separator is connected to a dust collection device.

Abrasive handling systems are designed to meet the requirements of a specific machine application. Some of the considerations used to design the system include:

- Type of metal being cleaned
- Type of contaminants being removed
- Amount of contaminants
- Type of abrasive media
- Volume of abrasive



(Fig. 24) *Airwash separator*

Fourth, the shot blast cabinet serves two purposes, it supports the centrifugal wheels and contains the high velocity abrasive particles preventing these particles from entering the work area around the machine.

The cabinets can be fabricated from mild steel plate and covered with replaceable wear plates. The wear plates are usually hard chrome iron castings.

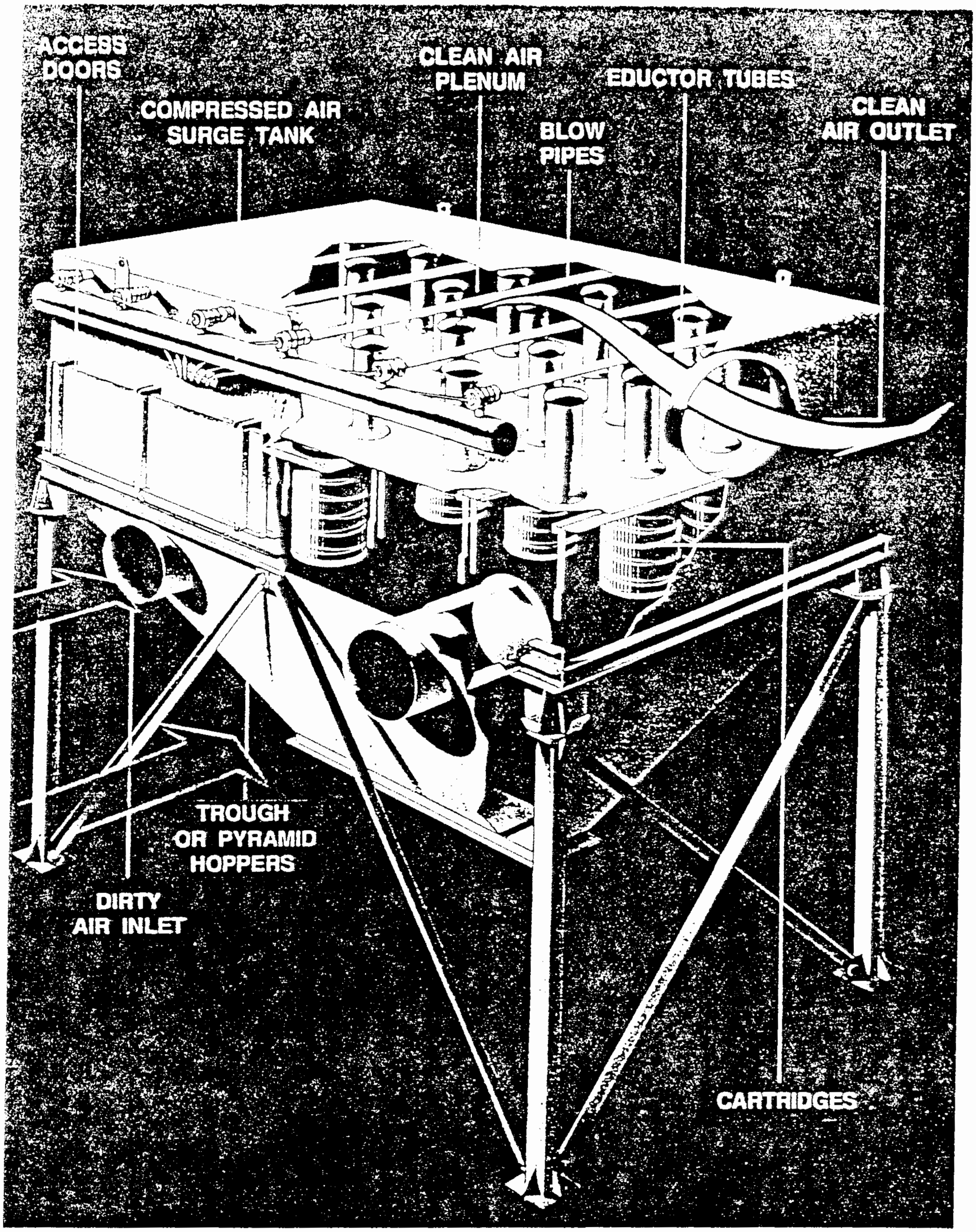
The use of Hadfield Analysis manganese steel has gained popularity in recent years. The manganese steel work hardens from impacting steel shot. Usually, the only wear plates required are those placed directly in line with the centrifugal wheel. This mode of manufacturing blast cabinets reduces the initial cost of the manganese cabinet vs. mild steel. It's cost effective once installed because extra wear plates do not have to be maintained.

The other important feature incorporated into the blast cabinet is the work opening sealing device. This can be a simple manual door, or a series of flexible finger seals that conform to the contour of the workpiece passing through the cabinet.

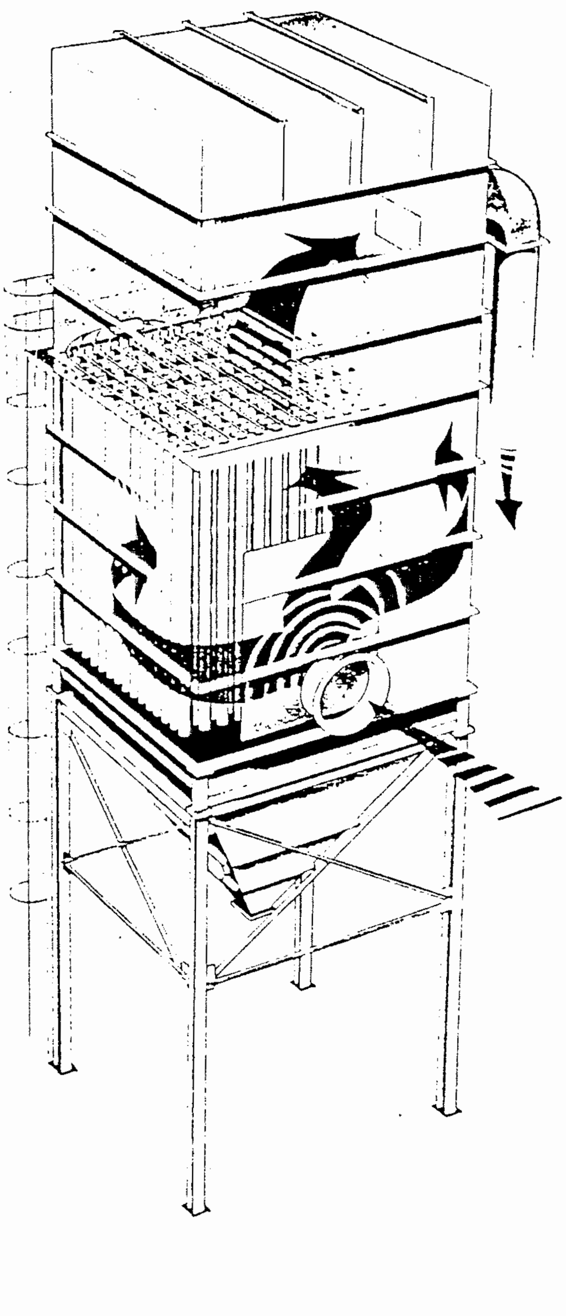
It's important to remember that centrifugal wheel machines propel thousands of pounds per hour of steel shot at a very high velocity. The abrasive particles must be contained within the cabinet to prevent injury to employees working near the machine.

Fifth, an important consideration is the dust collection system. Every blast cleaning machine generates dust of some type. Rust, pulverized mill scale, paint and other contaminants are removed from the surface of the part being cleaned. Air flow through the airwash separator is initiated by the dust collector. The blast cabinet usually requires six air changes per minute to remove the dust generated by the blast action.

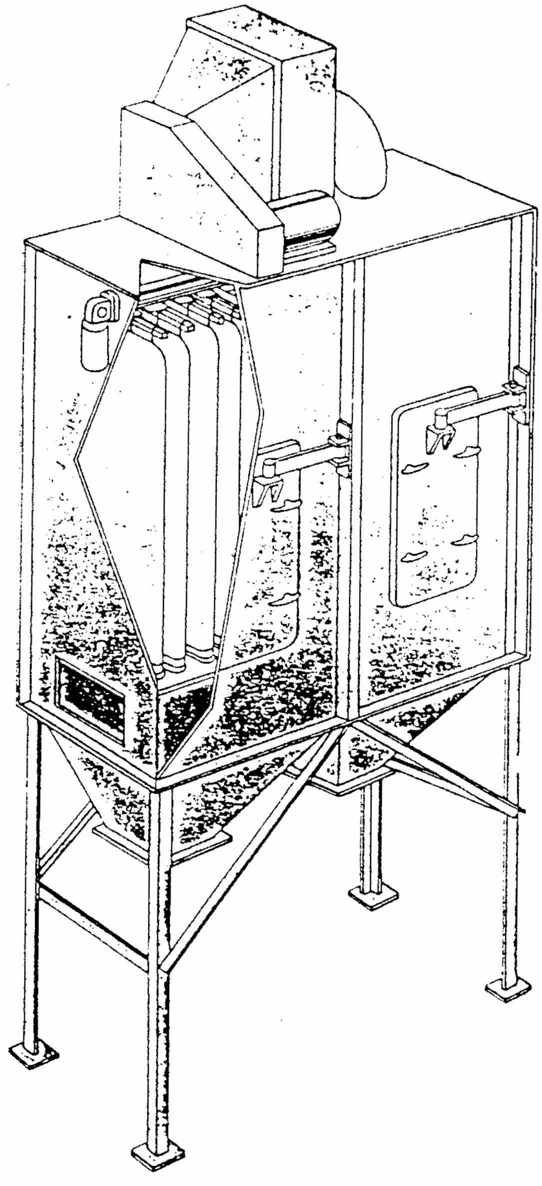
Figures 25 through 27 illustrate some of the types of dust collectors used in conjunction with shot blast machines.



(Fig. 25) *Cartridge type dust collector*



(Fig. 26) *High-Pulse type dust collector*



(Fig. 27) *Shaker type dust collector*

Summary

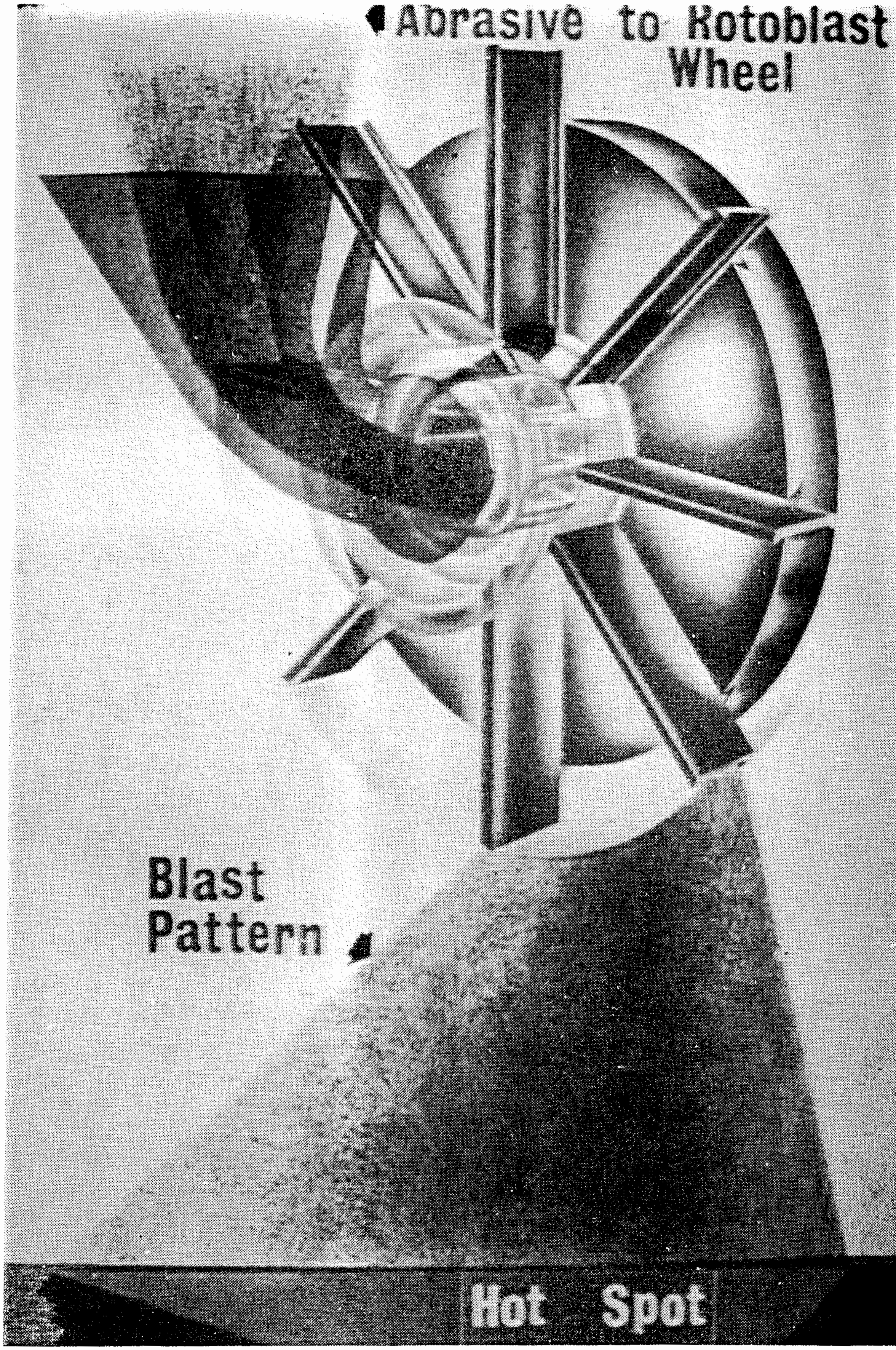
The selection of the "right" blast machine for your operation is not always an easy decision. There are many alternatives possible and often several different types of equipment will do the job (Fig. 28). The degree of equipment sophistication, urgency of the requirement and both operation and maintenance budgets are often extremely important factors in the final decision. We recommend you discuss your problems with a reliable, experienced new equipment manufacturer. Only then will the answers truly reflect what's best for you.

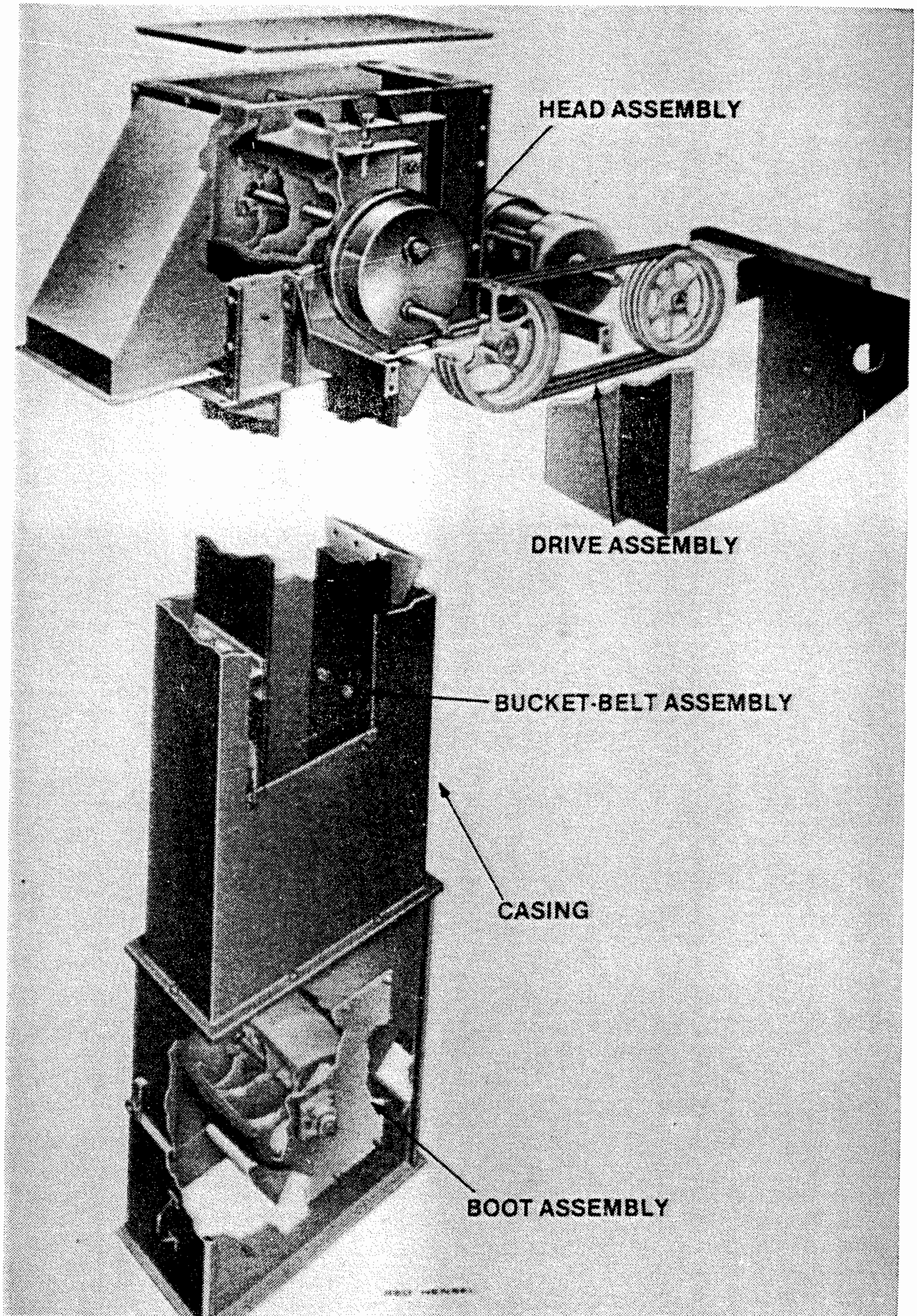
TYPE OF MACHINE	PRODUCTION RATE	PART COMPLEXITY	PART WEIGHT	CAN BE TUMBLED	PART TOUGHNESS
TUMBLING BARREL 1-12 ft^2	LOW TO MODERATE	SMALL & SIMPLE TO MEDIUM	25-100 lbs.	YES	HIGH
TUMBLING BARREL 15-72 $ft.^2$	LOW TO MODERATE	SIMPLE TO MEDIUM	100-2500 lbs.	YES	HIGH
CONTINUOUS BARREL	HIGH 10-40 TPH	SIMPLE TO MEDIUM	25-500 lbs.	YES	HIGH
HANGER MACHINE	LOW 20-30 HOOKS/HR.	SIMPLE TO MEDIUM	UP TO 6000 lbs.	NO	LOW TO MEDIUM
TURNSTILE	MODERATE-LESS THAN 60 HOOKS/HR.	VERY	UP TO 2000 lbs.	NO	LOW TO MEDIUM
POWER & FREE MONORAIL	HIGH-UP TO 120 HOOKS/HR.	VERY	UP TO 20 TONS	NO	LOW TO MEDIUM
CONTINUOUS MONORAIL	VERY HIGH-UP TO 750 HOOKS/HR.	VERY	UP TO 4000 lbs.	NO	LOW TO MEDIUM
SMALL TABLE 3'-6'	LOW	SIMPLE TO MEDIUM	UP TO 5 TONS	NO	LOW TO MEDIUM
LARGE TABLE 8'-12'	LOW	SIMPLE TO MEDIUM	5-20 TONS	NO	LOW TO MEDIUM
ROOM TYPE	LOW	SIMPLE TO MEDIUM	UP TO 250 TONS	NO	LOW TO MEDIUM
AXIAL FLOW	HIGH- 650 BLOCKS/HR 1000 HEADS/HR.	VERY	UP TO 350 lbs.	NO	LOW TO HIGH**

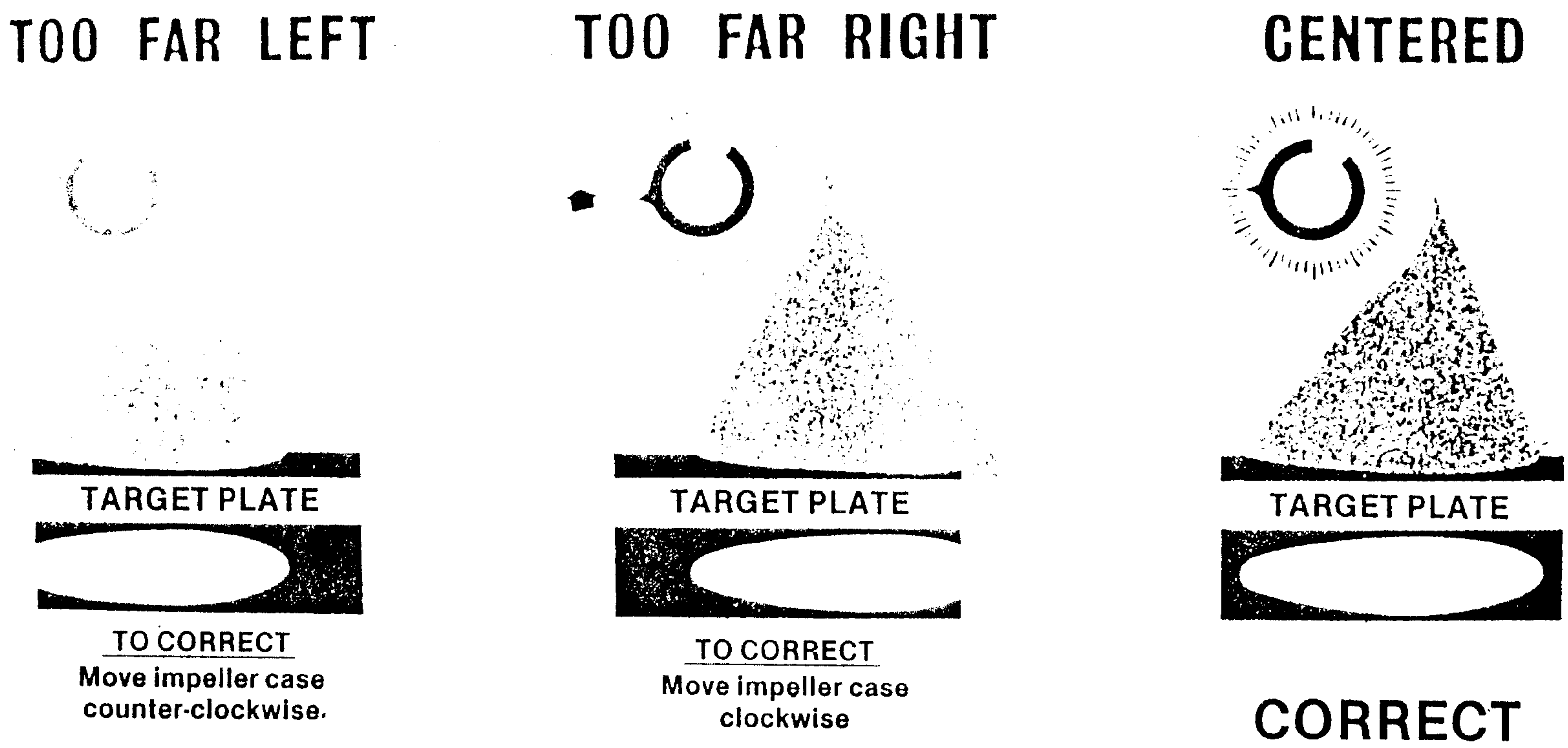
*This data compiled for general reference only.

**Depending on loading/unloading methods.

(Fig. 28) *Blast equipment parameters*


Abrasive to Rotoblast
Wheel
Blast
Pattern
Hot Spot


HEAD ASSEMBLY
DRIVE ASSEMBLY
BUCKET-BELT ASSEMBLY
CASING
BOOT ASSEMBLY


TOO FAR LEFT
TARGET PLATE
TO CORRECT
Move impeller case counter-clockwise.
TOO FAR RIGHT
TARGET PLATE
TO CORRECT
Move impeller case clockwise
CENTERED
TARGET PLATE
CORRECT