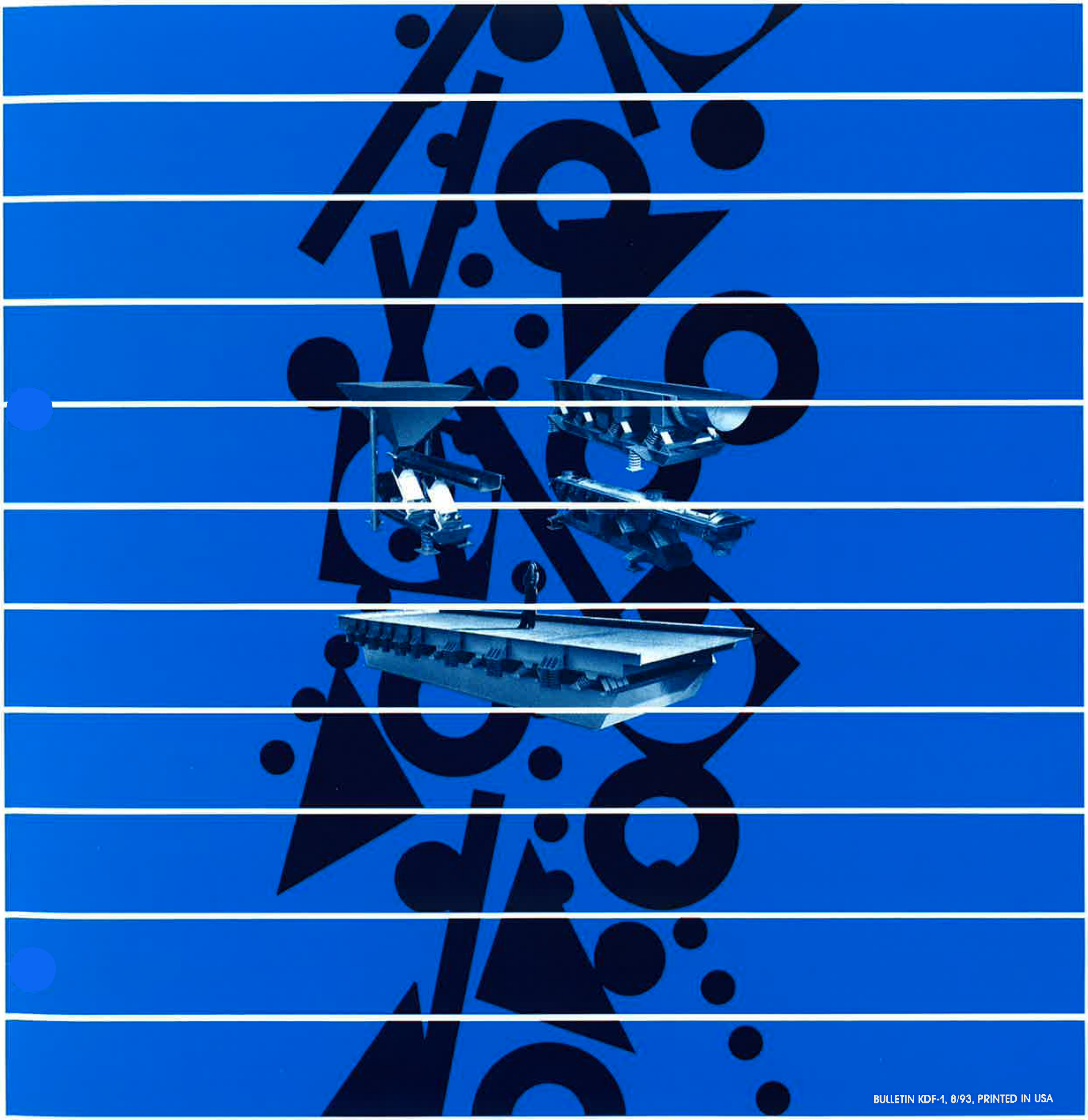
Induced Conveying

# Kinergy Driven Vibrating Feeders

Kinergy Corporation



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# ► Classifying Materials

# ► Benefits of Induced Conveying

Feeders are essential to material handling systems because they perform the same function as valves do for liquids. Namely, controlling the amount of material flow to the process downstream.

A "Feeder" is some type of conveyor that is combined with a means for storing the material to be fed. It almost always has an adjustable output.

The storage means, such as a surge bin or hopper, must be able to continuously supply the material at a flow rate that is slightly more than the maximum output of the feeder installed with it.

To accomplish the feeding function, the bulk solids or "unit pieces" can be conveyed or fed by being carried on belts, aprons, skip hoists, and tramways. They can also be impelled to move by an auger, drag-flight, and a rotary vane type feeder. Sliding them over reciprocating troughs or slats and being pneumatically fed are other choices.

**"Induced Conveying"** is another alternative, and it is accomplished by a vibratory action moving the material. The result is a conveying motion that is "induced" instead of being "forced". It usually is a very gentle movement. When it is necessary, a very sharp reacting type of vibration can be produced by using a steeper stroke angle.

After the electrically controlled "Electromechanical" type vibrating feeder was introduced in 1965, it easily demonstrated it could out-perform all the others in most applications. This included the "Electromagnetic" unit and the so-called "Brute Force" feeder that already existed. Consequently, thousands of them are currently in productive use all around the world. To this day, this kind of vibrating feeder still maintains its unchallenged position of leadership.

The reason for this sustained superiority is because the Kinergy Drive System makes it the most versatile and energy efficient vibrating feeder known.

## Classifying Materials

The typical materials conveyed on vibrating feeders are either "unit pieces" or bulk solids.

**Unit Pieces:** These are whole solids that are a complete entity. Examples would be bolts, fasteners, castings, filled bags, metal stampings, briquettes, or wooden logs (Figure 1). Others are whole batteries, rubber tires, green beans, cherries, tomatoes, beets, potatoes, apples or nuts. More entities include wooden board scraps, frozen french fried potatoes, fish scraps, or anything similar.

**Fig. 1:** Scrap steel is an example of "unit pieces".

**Fig. 2:** Wood bark typifies "Flake" type particles.

**Fig. 3:** "Floodable" bulk solids are very fine and dry.

**Fig. 4:** A granular texture, usually with lumps, denotes a "General" kind of bulk solid.

**Bulk Solids:** This type of material is made up of "particles". Since there are a myriad number of different bulk solids, they are classified into three groups to better understand their feeding characteristics.

**"Flakes"** are flat shaped particles or strands. They will compress when an external force is applied, such as squeezing them by hand (Figure 2).

Wood bark, shavings, or chips are examples. Others are glass fibers, polystyrene film, refuse derived fuel (RDF), wood waste, shredded rubber tires, metal turnings, brass needles, rock wool insulation, peanut shells, fresh spinach leaves, tobacco, or the like.

**"Floodable":** When the particles are very fine and dry, they easily aerate so they are said to be "floodable". The name calls attention to their being able to flow uncontrolled unless precautionary measures are taken. A particle size smaller than 100 mesh and less than 2% moisture content more specifically describes a bulk solid that is floodable (Figure 3).

Hydrated lime, fly ash, kaolin clay, pesticides, virtually all the different "dusts" from collectors, acetylene black, gypsum stucco, bentonite, talcum powder, diatomaceous earth, cement, ink dyes, carbon black, powdered milk, dextrose, powdered sugar, or anything similar exemplify bulk solids that are floodable.

**"General":** This type of bulk solid does not qualify as being either a flake or floodable. They are granular in texture and often have lumps in their particle size distribution (Figure 4).

Typically, coal, limestone, gypsum, sawdust, bottom ash, rice grits, salt, bone meal, corn gluten, soybean meal, granulated sugar, fertilizer beads, molding sands, and potash denote the "general" classification of bulk solids.

## Benefits of "Induced Conveying"

All vibrating feeders utilize the principle of "Induced Conveying".

It is accomplished by imparting a proper stroke, which is preferably linear, at the needed frequency, to the material. The applied vibration inherently reduces the "inter-piece" or "inter-particle" friction of the moved material. Since the motion is

**Conveying Methods**

| THE METHODS: | "CARRIED" | "IMPELLED" | "SLIDING" | "PNEUMATIC" | "INDUCED" |
|---|---|---|---|---|---|
| **PRACTICAL EXAMPLES:** | Belts, Aprons, Tramways & Skip Hoists | Augers, Drag Flights & Rotary Feeders | Reciprocating troughs or slats | Dilute or Dense Phase | Vibrating Feeders, Conveyors, Screens, Spirals, Fluidized Beds, and Foundry Units. |

**Fig. 5:** Bulk solids or unit pieces can be moved by various methods. They can be "Carried" on belts, skip hoists, and tramways or "Impelled" to convey by augers and drag-flights. "Sliding" over reciprocating surfaces or being "Pneumatically" transported are other choices. Another alternative is "Induced Conveying".

# The History of Vibrating Feeders

"Induced", not forced, it usually has the advantage of being a very gentle type of conveying. Conversely, and when it is needed, a very abrupt or sharp reacting type of linear stroke can be produced by utilizing a more steep drive angle.

In comparison to other feeding methods (Figure 5), "Induced Conveying" by a vibrating feeder has many benefits. Some of them are:

**Minimal Abrasion:** Highly abrasive materials can be fed with very little wear on the feeder's trough surfaces. The gentle "pitch and catch" movement makes this possible (Figure 6).

**Fig. 6:** Feeding abrasive rocks without excessive wear.

**Fig. 7:** Vibrating Feeders can have their troughs enclosed or made "dust-tight". Flexible connections are needed at the feeder's inlet and outlet.

**Dust-Tight Construction:** By applying trough covers and suitable flexible connections, a vibrating feeder can be completely sealed or made "dust-tight" (Figure 7).

**Self-Cleaning:** All vibrating feeders or any other "Induced Conveying" unit are inherently self-cleaning of the material being fed (Figure 8). This makes them desirable for sanitary applications or when material contamination is to be minimized or avoided.

**Fig. 8:** The "self cleaning" feature and a sanitary design are needed in the Food and Pharmaceutical Industries.

**Wide Temperature Ranges:** Extremely cold or hot (to 3500° F.) bulk solids or unit pieces can be successfully fed by vibrating feeders. Modified trough designs may be required, but the ability to deal with the wide temperature range of materials is a basic benefit of any "Induced Conveying" unit.

**No Return:** Vibrating feeders do not have any "return" element such as would be encountered with a belt, apron, or drag-flight type feeder. Therefore, nuisance "tailings" falling from these returns are eliminated.

**Multi-Function:** In addition to feeding, other functions can be simultaneously performed. Examples would be sub-dividing the feed into smaller streams, multi-point distribution, or screening (Figure 9).

When the vibrating feeder has an adjustable output, even more versatility in its application can be realized.

**Fig. 9:** Other functions, such as screening, can be performed while feeding.

**A full "zero to maximum" range of feed rates** is available. Other kinds of feeders can be limited to a lesser range of outputs because of the type of mechanical or electrical drive they utilize.

**Minimal Attrition or Degradation:** The vibratory feeding action can be a very gentle "induced" movement. Therefore, particle to particle degradation or attrition of the material being fed is virtually eliminated.

## The History of Vibrating Feeders

The first vibrating feeder was the "Electromagnetic" type (Figure 10). It produced a high frequency "buzzing" kind of vibration which has an inherent linear or straight line stroke pattern. It could be electrically controlled over its full range of output because this feature is innate to any electro-magnet. The feeder's stroke changes, but its operating frequency stays the same. Conceived in 1928, it was considered to be the best vibrating feeder available for many years. Primarily, because of its simple method of electrical control.

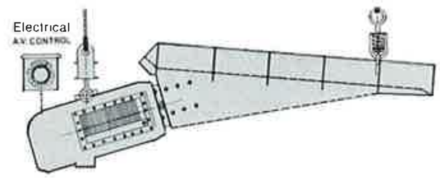



**Fig. 10:** The Electromagnetic feeder developed in 1928. It prevailed as the most popular feeder for many years because it had a full range of electrical control.

When a high headload, shock, or impact loading had to be endured, the Electromagnetic feeder could not be used. This need prompted the development of a second type of vibrating feeder in the 1930's. Since its power source was an electric motor instead of an electro-magnet, it was identified as being "Electromechanical". Utilizing the "Single Input" type of vibratory drive system, it is more commonly called "Brute Force" because the motor is the sole source of the vibratory power (Figure 11).

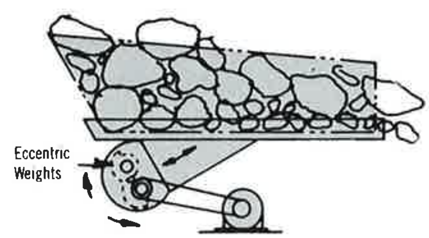



**Fig. 11:** The "Single Input" or "Brute Force" driven feeder that appeared in the 1930's. Since it used a motor instead of an electromagnet, it was called "Electromechanical". It could tolerate severe "load abuse". Whereas the Electromagnetic feeder could not. It also showed a better performance level. Consequently, and in time, the quest began to make it adjustable in output by some practical method.

This kind of feeder satisfied the requirements of an abusive loading application, such as a primary crusher feeder.

Nevertheless, the Electromagnetic feeder continued its popularity even though it has limitations. The Electromechanical feeder was slowly demonstrating better performance capabilities. Particularly, in being able to build heavier and larger width units, providing the motor in dust-tight or explosion proof enclosures, avoiding "single phase" power loadings, and using lower frequencies at better stroke angles to achieve more capacity per unit of width. It was finally reasoned that if it could have an

# History
**(Continued)**

# The Kinergy Driven Feeder

adjustable output, it would be the better feeder. Therefore, in the 1950's, the quest began to find a way to readily vary the output of an Electromechanical type of feeder by some practical means.

The initial invention in this regard was to insert air bags in front and behind a vibratory motor turning eccentric weights. This was done in 1958. By changing the air pressure inside the air mounts, the feeder would alter its stroke, while its operating frequency remained constant (Figure 12).

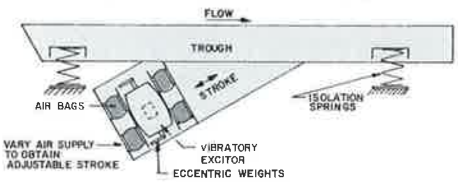



**Fig. 12:** The first idea to change the output of an Electromechanical feeder was to vary the air pressure in rubber bags installed on both sides of the motor. It was invented in 1958.

Therefore, the feeder's output was adjusted. While expensive, and the control method required a source of compressed air, it clearly confirmed the anticipated performance benefits of an Electromechanical feeder as compared to one that was Electromagnetic. This idea was followed in 1964 by two other very clever adjustable rate designs for vibrating feeders that utilized a motor (Figures 13 and 14). Although each of these units had a measure of success, the Electromagnetic feeder still led the field because they all used a "mechanical" means to obtain their rate adjustment. Consequently, the search continued for a more appropriate means for adjusting the rate of an Electromechanical type of vibrating feeder.

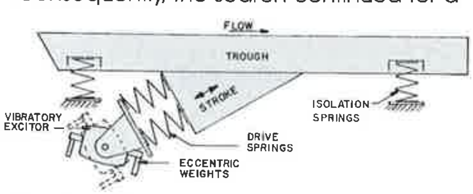



**Fig. 13:** This feeder was announced in 1964 and it tilted the position of the motor to alter its output.

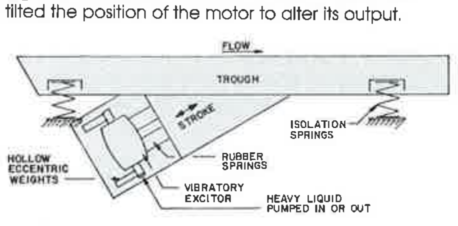



**Fig. 14:** The motor's dynamic force output was varied in this feeder by changing the amount of heavy liquid, such as mercury, in the hollow eccentric weights. Consequently, the feeder's stroke changed and so did the feed rate. It was also introduced in 1964.

In 1962, the first Bin Activators were being introduced to Industry. This vibratory machine was used to discharge bulk solids from storage bins, so it was a marked departure from vibrating feeders. Nonetheless, the seed for the next gainful contribution was to be found there (Figure 15). Because of repeated performance problems with some of these early Bin Activators, their basic mathematics were changed to vector equations in hopes of better pinpointing the difficulties. This precipitated the formulation of the vectorial "Drive vs. Load" analysis in 1964. It could be applied to any kind of vibratory machine, which included vibrating feeders. Eventually, from this different analytical approach came the discovery of an A.C. squirrel cage motor rotating relatively small eccentric weights, and combined with "Sub-Resonant" tuned drive springs, to possess a full range of an adjustable output by simply varying the voltage of its power supply. It was 1965, and this simple method of electrical control made the Electromechanical vibratory feeder totally viable and practical. It also marked the first time an A.C. squirrel cage motor could have its running speed altered by only varying its applied voltage. As the record shows, it met with immediate success and it still leads all the other kinds of vibrating feeders available today (Figure 16).

**Fig. 15:** The field follow of the Bin Activator instigated the formulation of the "Drive vs. Load" analysis in 1964. It could be applied to any vibratory machine, which included a vibrating feeder.

**Fig. 16:** The new analytical theory prompted the discovery of a simple method of electrically controlling the output of an Electromechanical feeder. This was done in 1965.

The design configuration of the feeder shown above was the initial concept. This electrically controlled feeder, which utilized a motor, easily outperformed all the others in most applications. Therefore, it met with immediate success. This kind of feeder was the "birthplace" of the Kinergy Drive System which now powers all the other types of "Induced Conveying" machines.

Originally, it was only thought of as an improved vibrating feeder because that's what it was intended to be.

In the years that followed, the versatility and energy efficiency of this type of vibrating feeder gradually convinced those who had developed it to realize a "vibratory drive system" had been advanced by this innovation and not just a vibrating feeder. Consequently, in 1978, it was boldly decided to universally adapt this kind of vibratory drive system to all the other "Induced Conveying" machines. This included Vibrating Conveyors, Screens, Heat Transferring units, and the like. Therefore, the beginnings or the "birthplace" of what is commonly called the Kinergy Drive System was when the electrically controlled, Electromechanical type of vibrating feeder was introduced almost thirty years ago.

For powering vibrating feeders or any of the other "Induced Conveying" machines, it has proven to be the most versatile and energy efficient vibratory drive system known.

## The Kinergy Driven Feeder

Combining a "Free Force" input from an A.C. type electric motor with the output of "Sub-Resonant" tuned springs describes the Kinergy Drive System. When the applied load increases, the springs inherently drive harder. Stated differently, relatively small rotating eccentric weights installed on the extended shafts of a motor sustain the vibratory motion of the reactive power producing drive springs (Figure 17). Its output can be electrically controlled over a very broad range.


**Fig. 17:** The Kinergy Drive System has only three component parts. The steel coil drive spring that produces "Kinergy", the stabilizer to guide it, and the motor that supplies the needed heat energy to sustain the vibratory motion.

It maximizes the effective use of "Kinergy", which is the kinetic energy developed by a spring's motion during the drive portion of its cycle. Since the

# ▶ Circular or Unidirectional Feeders

# ▶ The Vibratory Conveying Action

Kinergy vector is much larger than the one for the motor, it is commonly called the "Kinergy Drive System", and vibratory machines using it are said to be "Kinergy Driven".

Understandably, other manufacturers are attempting to provide a similar kind of vibratory feeder. This includes those who had previously earned their reputations by making the Electromagnetic type. Their differences are evident by noting a lesser range of feed rate control, the use of rubber springs that wastefully consume more power, the shallow stroke angle that reduces capacity, the squeezing of all the drive components into one assembly, their limited lengths, or avoiding "dust-tight" trough designs. All the effort to try to duplicate the Kinergy Driven Feeder is actually another testimonial to it being the most versatile and energy efficient.

## Circular or Unidirectional Feeders

Vibrating feeders most often convey "unidirectionally". This means the material is being moved in a single direction (Figure 18).

Circular feeding units develop a helical stroke action which moves the material around in a circle in the horizontal plane (Figure 19).

**Fig. 18:** A "unidirectional" feeder which conveys the material in a single direction.

**Fig. 19:** A "circular" feeder conveys the contained material in a circular path.

## The Vibratory Feeding Action

The stroke pattern for all Kinergy Driven unidirectional feeders is uniformly "linear" or a straight line. Circular units have a uniform linear stroke around their periphery (Figures 20, 21 and 22).

The stroke angle can vary from being shallow to one that's very steep as required by the application (Figure 23).

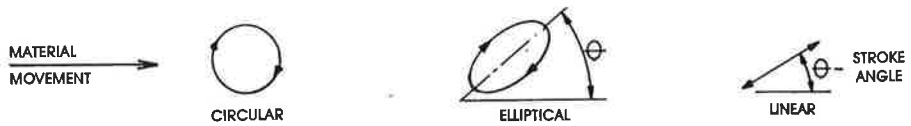



**Fig. 20:** Of these stroke patterns, the "linear" one, as shown on the right, is the most efficient for accomplishing vibratory conveying.

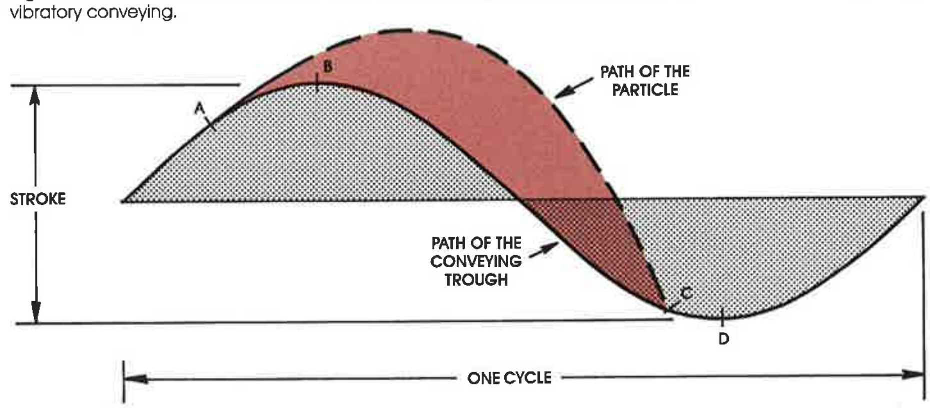



**Fig. 21:** The wanted path of a particle being moved by vibration. The particle leaves the trough at point "A". It follows a free projectile path and then re-engages the trough at point "C". The extremes "B" and "D" represent the maximum amplitude of the unit's stroke.

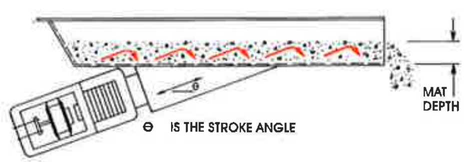



**Fig. 22:** A particle or "unit piece" can be vibrated and conveyed over a hard surface by means of a series of repetitive "hops". It is nearly the same as a grasshopper's consecutive jumps, or likened to a child advancing on a "pogo stick". Each "hop" is a cycle. The distance "hopped" is directly related to the unit's stroke length and the angle at which it is applied. The "hops" per unit of time is the operating frequency which is usually expressed in "cycles per minute" or CPM.

When a vibratory machine moves its material load by vibration, it is utilizing the principle of "Induced Conveying". All vibrating feeders, conveyors, screens, heat transferring units, attrition mills, or the like, have this in common.

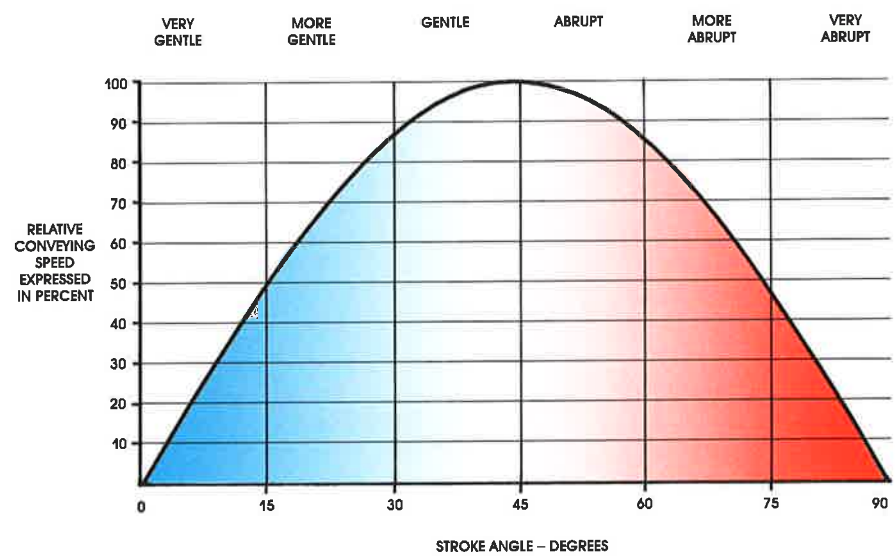



**Fig. 23:** This curve shows the resulting vibratory action and unidirectional conveying speed for the various stroke angles. The conveying force is held constant at 3.5 "Gee's". When the linear stroke is less than 45°, the vibratory movement is "gentle". For stroke angles above 45°, it is more abrupt or "sharp" reacting as it conveys.

(a) By reducing the vibratory force or "Gee's", the conveying speed reduces and the movement becomes more "gentle" for all the stroke angles.

(b) By increasing the vibratory force or "Gee's", the conveying speed increases and the resulting action is less gentle or has a higher degree of abruptness.

# ▶ Added Functions Accomplished While Feeding

A high frequency, short stroke, "buzzing" type of vibratory action generates an intense "surface" action, but sacrifices "mass penetration". This is the reason Electromagnetic units do not have a high conveying capacity when it's needed for feeding. Their high frequency vibration cannot fully penetrate a deep mat depth. Whereas, a lower frequency, longer stroke vibration will penetrate up through a very deep mat depth, but it has a lesser surface intensity which is normally not of consequence when feeding. Following this premise, most operating frequencies of Kinergy Driven Feeders are 855 CPM in order to move larger quantities of materials. When it is more beneficial, other frequencies with their corresponding strokes are utilized (Figure 24).

| Stroke (Inches) | Frequency (CPM) |
|---|---|
| 1/32 | @ 3600 (60 Hz) |
| 1/8 | @ 1710 |
| 3/16 | @ 1140 |
| 5/16 | @ 855 |
| 7/16 | @ 685 |
| 3/4 | @ 570 |
| 1 | @ 470 |

**Fig. 24:** The various compatible strokes and frequencies for the feeding of bulk solids or unit pieces by a vibratory action with a 60 hertz electrical power supply.

## Accomplishing Additional Functions

While the bulk solid or unit pieces are being fed, some added functions can be performed.

**Batch Weighing:** Usually a vibrating feeder equipped with a "dump hopper" performs this function. By using "load cells", the feeder and its contained "batch" are weighed (Figure 25). After the weight is noted, the load cells are usually disengaged and the "batch" is fed to the receiving unit, which is often a furnace or mixer.

**Fig. 25:** This "dump hopper" feeder supplies weighed "batches" of scrap metal to a furnace. It is mounted on a rail wheeled cart that is equipped with load cells with a digital read-out of the contained weight.

**De-wadding, De-clumping, or Fluffing:** Sometimes "Flakes" or cohesive "General" type materials are wadded or clumped together inherently or from previous steps in their handling. When they are, vibrating feeders can "de-wad" or de-clump the material or "fluff it up" as it is being fed (Figure 26).

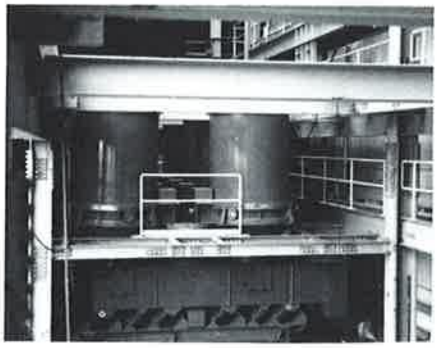


**Fig. 26:** When "refuse derived fuel" (RDF) is fed to a boiler, it needs to be "fluffed up" and not wadded for better burning.

**Loss in Weight:** A storage means, such as a surge bin, and the feeder can be combined and supported on a set of load cells. As the stored material is being fed, the combination's "loss in weight" reveals the accurate feed rate.

**Removing Ferrous Metals:** By installing an electro-magnet adjacent to the discharge end of a vibrating feeder, unwanted pieces of ferrous metal can be extracted from the falling mat depth of material. To ensure the extraction of all the metal, the material's mat depth may need to be limited. That portion of the feeder's trough that is near to the electro-magnet may be constructed of an appropriate non-magnetic material such as stainless steel or fiberglass.

If the feeder's conveying trough is long enough, the electromagnet can be installed directly above it.

**Screening:** Some screening functions can be simultaneously achieved while feeding. Even so, the needed "degree of screening efficiency" will actually determine the design of the unit. Further, the automatic electrical "pulsing" of the feeder will most likely be required for many applications. This abrupt pulse helps to sustain the screening function when the feeder is operating at a lesser output.

**Cleaning:** Most "cleaning" functions can be achieved provided the screening surface is long enough.

**Sizing:** If the screening efficiency is not overly important, then it can be done on a vibrating feeder. Most often, it is "scalping", but it can be removing "undersize" or even "size grading" (Figures 27 and 28). Conversely, when a high degree of screening efficiency is required, the feeding unit will be designed as a vibrating screen.

**Fig. 27:** Grizzly bars are often used at the discharge end of the feeders to remove "undersize" particles. When "screening" efficiency is important, the required "screen area" must be available to accomplish it.

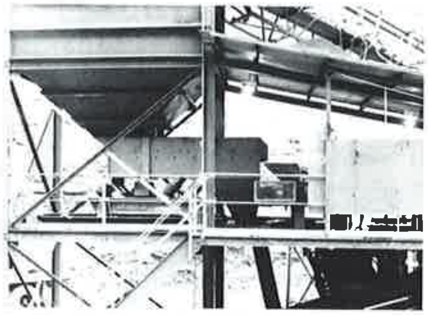


**Fig. 28:** This 4 ft. wide by 10 ft. long feeder has a screening deck to remove minus 1" coal while performing the feeding function.

**Deliquefying:** If the liquid is only to be "drained", it can be accomplished (Figure 29). When the conveyed material is to be reasonably deliquefied, the unit's design would be in agreement with a vibrating screen.

**Spreading:** The inlet end of the feeder is relatively narrow. While the material is being unidirectionally conveyed, its mat depth reduces as it "spreads" across a larger width prior to being discharged.

**Subdividing the Fed Material:** By means of vertical trough dividers, the incoming supply of stored material can be subdivided into a number of reasonably equal flow streams (Figure 30). By the use of manual or air-operated gates installed at the outlets, the conveyed contents can be discharged at various points along the unit's length.

# Applying Kinergy Driven Feeders

**Fig. 29:** A water draining screen is in this feeder.

**Fig. 30:** The inlet of this feeder is kept full of "RDF" or wood waste such as bark, chips, shavings, or sawdust. As the fuel moves forward, it is subdivided into three feed streams that supply a "fluid bed" type combustor of a boiler.

## Applying Kinergy Driven Feeders

The feeders can be circular or unidirectional in their direction of conveying.

"Unit pieces" convey very well on vibrating feeders because they are usually dry and "rigid" in their make up.

"Flake" type particles are appropriately fed. Since they are resilient, they will convey a little slower than those which are more rigid. Usually, added moisture does not adversely affect their conveyability. When it does, this peculiarity needs to be taken into account.

"Floodable" bulk solids can be safely fed with circular feeders. When the unidirectional kind are used, this material should be respected for its ability to aerate and vertically flow from the storage means and gush over the feeder's trough in an uncontrolled manner.

The "General" class of particles are readily fed by vibrating feeders. More applications are in use with this kind of material than any other. Their particle structure is often rigid, which enables them to favorably respond to a vibratory action.

**Circular Feeders:** The amount of usable storage volume governs the selection of this type of feeder. Their outputs can be "ounces per minute" to an upper limit of about 50 TPH.

Cylindrical in shape, the incoming material can be continuously or batch dumped into the center portion of the feeder. The stored material circularly conveys and moves outward. It engages the spiraling trough and is lifted up by it. After being conveyed to the top of the peripheral spiral, the fed material is discharged (Figure 31).

**Fig. 31:** A circular feeder with limited storage volume.

The needed feed rate dictates the width and the number of the conveying tracks that spiral around the inner wall of the feeder's periphery.

Volumetrically, these units are 1 cu. ft. through 2,000 cu. ft. as a standard. Dimensionally, the cylindrical feed section can be up to 18 ft. in diameter. The vertical height is normally one-half the diameter, but it can be increased to achieve more stored volume.

When "screening" is an added function, it is either done on the bottom of the cylinder or on the conveying tracks. Subdividing the feed streams is accomplished by having a separate spiral track for each one that's required.

This kind of vibrating feeder can successfully contend with all the bulk solids, which are "Flake", "Floodable", and "General", provided they reasonably respond to the conveying action. "Unit pieces" of the proper physical size can also be fed.

**Unidirectional Feeders:** This is by far the most popular kind of Kinergy Driven Feeder. It can have a controlled output that spans from only "ounces per minute" to maximum rates as high as 10,000 tons per hour!

When they feed crushers, shredders, hammer mills, chippers, or the like, their widths should coincide with the inlets of these machines so they will have a more uniform wear on their rotating parts. Otherwise, the width of the feeder is usually related to the output capacity needed for the application.

Unidirectional feeders are normally applied in one of two different situations. Namely, being installed under a storage bin, silo, or pile, which is most often the case. The other is being inserted under a "dump hopper" which sometimes has the latter included as part of the feeder.

**Installation Under Bins, Silos, or Storage Piles:** The first consideration is to ensure the stored material will be able to vertically flow from the storage means at a continuous rate that is slightly more than the maximum output of the feeder installed under it. With respect to the storage means, the guidance of a consulting engineer qualified in "Static Design" technology or the use of the principle of "Induced Vertical Flow" would assure this basic requirement would be met.

The second factor is to recognize that the stored material is changing its flow direction from vertical to essentially horizontal. As it makes this turn, the material's cross-sectional flow needs to be uniform. A dormant or a non-flowing portion on the upstream end of the feeder is to be avoided (Figures 32 and 33). To cater to this needed material flow phenomenon, the proper "interface" of the feeder with the outlet of the storage means is required. Further, the feeder's length, width, and the degree of controllability will also depend upon the type of "interface" layout chosen to accomplish the needed capacity of the TPH output. There are two layouts for determining the feeder's trough length. One achieves a "Maximum Capacity" per unit of width of the feeder (Figure 34) and the other is a "Conveying Capacity", which has the best controllability (Figure 35).

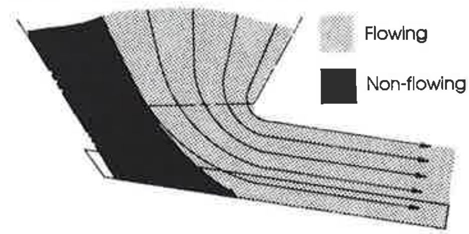



**Fig. 32:** A vibrating feeder that is incorrectly interfaced with the outlet of a bin. The upstream layers of material are not flowing and become dormant. Consequently, this portion of the material "packs" or densifies.

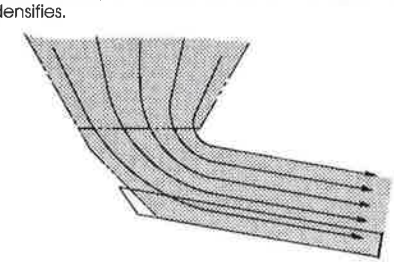


**Fig. 33:** A correctly "interfaced" feeder. The material flow is nearly uniform as it makes the turn from vertical to essentially horizontal.

When feeding "unit pieces", the feeder is usually installed horizontal, but

# Applications
## (Continued)

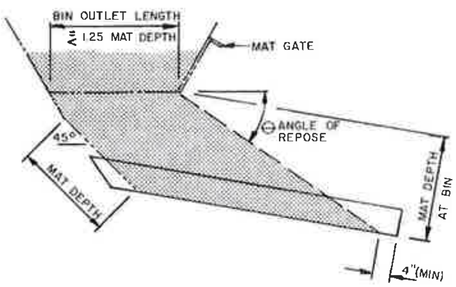



**Fig. 34:** A "Maximum Capacity" trough length layout.

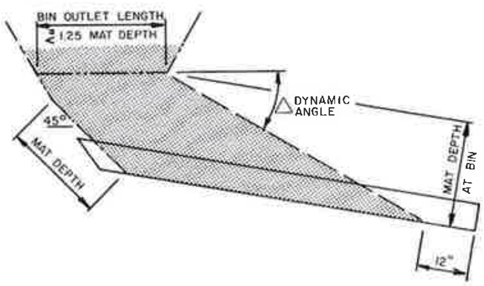



**Fig. 35:** A "Conveying Capacity" trough length layout.

declines to 10 degrees are sometimes used.

For "Flake" or "General" type bulk solids, the feeder can be installed horizontally, but it is usually declined at least 7.5 degrees and often to 15 degrees to achieve more output per unit of width.

"Floodable" materials are normally limited to relatively small feeders that have their troughs horizontal or slightly inclined uphill.

**Feeders Combined with a Dump Hopper:** This kind of application subdivides into two categories.

**One is when the vertical height consumed is not the primary concern.** If so, the conceptual design of the "dump hopper" is essentially the same as the transition section used in the lower portion of a storage bin. In this instance, the feeder is interfaced with the outlets in the same manner as discussed for bins in the previous section. "Maximum Capacity" layouts are normally avoided. Instead, the one for "Conveying Capacity" is used. The longer trough length minimizes the material gushing over the feeder's discharge end when the initial impact of the "dump" strikes the empty trough (Figure 36). Sometimes the configuration of the "dump hopper" compartments will require the feeders to have different feed rates so they can timely remove a given volume of

**Fig. 36:** This truck dump hopper is essentially the same as the lower part of a storage bin.

dumped material. For example, if a 100 ton rail car is being unloaded and there are three compartments, the feeder under the center outlet will most likely have a higher output than the other two because it has to discharge more volume of the dumped material.

**The other application has the advantage of the feeder becoming the "flat floor" of the dump hopper so it can achieve the most amount of storage in the least amount of height.** It is a form of "Impelled Retrieving" because the stored material is being conveyed out of storage. The dump hopper can be separately supported and the vibrating feeder independently installed underneath (Figure 37). As an alternative, the

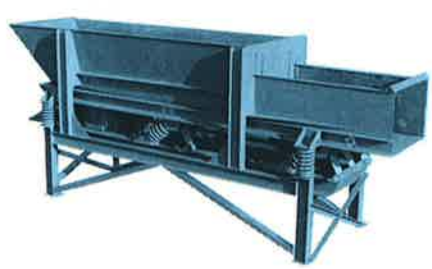


**Fig. 37:** The dump hopper is stationary. The long length vibrating feeder is under it.

**Fig. 38:** The tapered slot openings that are often needed at the bottom of non-vibrating dump hoppers.

dump hopper can become an integral part of the feeder and the assembly would vibrate as a complete entity. The dimensions of the "dump hopper" are normally based upon the amount of volumetric storage needed. The feeder's width will relate to the feed rate, but it can be increased to achieve more storage space in the least amount of height. The length of the feeder will be governed by the wanted storage volume or the needed "loading zone" dimension, plus an allowance at the discharge end for either the "static" or "dynamic" friction angle of the material being fed. If the dump hopper is made stationary, it will usually require a tapered outlet across its bottom length (Figure 38). This enables a more uniform flow of the material from the hopper above. When the hopper is made an integral part of the feeder, the tapered slot is not required because the entire assembly vibrates (Figure 39).

**Fig. 39:** The "dump hopper" is an integral part of this feeder.

**In either of these applications,** the hopper is typically filled by front end loaders, crane hoists, truck dumps that can contain 30 tons of material, or rail cars being "rolled over" to empty their contents, which could be a 100 ton load.

Scrap yards, "tipping" floors, belt conveyor loading stations, rotary rail car dumpers, and primary crusher feeders are all examples of "dump hopper-feeding" applications.

Most "dump hopper" feeders are installed horizontal or only slightly declined. When higher capacities are needed, such as being installed under rotary car dumpers, they will probably be declined 10 to 15 degrees. They are almost always supported from underneath because of their repeated impact type loading.

Unit pieces and Flake and General type bulk solids are normally handled with dump hopper feeders. Seldom are "Floodables" fed by them. When they are, the hopper-feeder combination needs to be made as "dust-tight" as it can be, and the proper precautions taken to avoid the material flowing in an uncontrolled manner.

- **Load Abuse Capability**
- **Larger Dimensions**
- **Counterbalancing**
- **Dust-Tight Construction**
- **Simple Electrical Control**

## Load Abuse Capability

One of the major attributes of a Kinergy Driven Feeder is its inherent load abuse capability; provided the feeder is built strong enough. The "free force" input, by means of relatively small rotating eccentric weights and the "sub-resonant" tuned drive springs, makes this possible. This load abuse capability is dramatically demonstrated by observing Kinergy Driven Primary Crusher Feeders in operation (Figure 40). In that application, the vibrating feeder repeatedly endures some of the most severe impact or shock loadings.

**Fig. 40:** Primary Crusher Feeders are one of the best examples of "load abuse" capability. The feeder is 5 ft. wide by 20 ft. long and it consumes 7.5 HP. The truck trailer is dumping 30 ton loads.

## Larger Dimensions

Since the Kinergy Drive System permits the "distribution" of the drive springs around the circumference or across the width and along the length of the vibrating feeder, the dimensions of the unit are not restricted. While the increased widths are impressive, the ability to build a feeder with the length that's needed is the most significant advancement.

This is one of the important differences between this kind of vibrating feeder and the older Electromagnetic or "Single Input" driven units which necessarily had to "concentrate" all their driving forces at one location. Therefore, their widths and lengths are limited for structural reasons.

Being able to "distribute" the driving forces is the reason Kinergy Driven "unidirectional" feeders are available in widths to 12 ft. in standard designs and the lengths as required (Figure 41).

Circular feeders are available to 18 ft. in diameter for the same reason. Namely, the helical motion producing drive springs are distributed around the circumference so the structural integrity of the circular unit is readily retained.


**Fig. 41:** The Kinergy Drive System makes it possible to offer the smallest to the world's largest unidirectional feeder. The one on the bottom is 2 inches wide by 15 inches long. The world's largest is 12 ft. wide by 38 ft. long.

## Counterbalancing

All Kinergy Driven Feeders are dynamically "counterbalanced". This is inherent in their modern design. A reaction member is introduced on the other end of the drive springs and it moves as the dynamic equal to the feeding trough. In turn, it is supported by relatively soft isolation springs which are usually of the steel coil type, at mounting points along the length of the counterbalance. This stable method of counterbalancing is readily demonstrated by observing Kinergy Driven Primary Crusher Feeders as they shift from the empty to the fully loaded condition in a time period that is usually measured in seconds.

While the vibratory dynamic forces can be isolated to a high degree, their operating frequency will not be. This is why a nearby entity, such as a hand rail or light weight structural member, may sympathetically vibrate with the feeder while it is in operation even though the unit is dynamically "counterbalanced".

## Dust-Tight Trough Construction

When unidirectional feeders with a conventional trough are installed, stationary skirtboards and their respective liners, as well as an outlet extension from the storage means above, such as a bin or storage pile, have to be supplied. While attempts have been made to make this configuration dust-tight, it usually hasn't been successful over the long term usage of the feeder.

This practical situation, plus the growing ecological requirements, has prompted the development of the dust-tight trough design feeder (Figure 42). It eliminates the stationary skirtboards, and it has the proper flexible inlet and outlet connections to adequately seal the unit. Since the feeder's inlet must remain aligned with the outlet of the bin, silo, or pile above, dust-tight units should be supported from underneath. If they must be suspended, other measures may be needed to retain this alignment.

Dust-tight trough design feeders are recommended anytime dust emissions from the material being fed are to be minimized or avoided. Particularly, when the feeders are located in a building populated with workers or when they are installed in a tunnel under a storage pile.

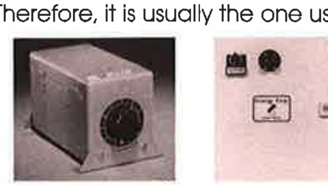
**Fig. 42:** Dust-tight trough design feeders should be used when dust emissions from the material being fed are to be minimized or avoided.

## Simple Electrical Control

All Kinergy Driven Feeders will smoothly provide a "zero to maximum" output (TPH) adjustment by simply varying the single or three phase voltage being applied to the A.C. squirrel cage motor providing the input power to the unit.

A manual variable auto-transformer or a solid state "silicon controlled rectifier" (SCR) is used to provide the variation in voltage to the motor (Figure 43). They both have an A.C. input and output, so no D.C. power is involved. Normally, they are only the source of the "Variable Voltage". Any needed branch circuit protection, linestarters, motor overload protection, interlocks, or the like are usually supplied "by others". When it is preferred, they can be provided by Kinergy.

The SCR type of controller includes the "full voltage" start feature. It can also automatically follow an electrical command from an external source, which is usually a 4 to 20 milliamp d.c. signal. Therefore, it is usually the one used.



Manual Variable Auto Transformer — Silicon Controlled Rectifier (SCR) Unit

**Fig. 43:** The two different types of "variable voltage" electrical controllers.

## ► Location of Drive
## ► Trough Configuration
## ► Abrasion
## ► Liners
## ► Corrosion

**Linearity:** As illustrated in Figure 44, the feeder's output (TPH) is essentially linear over its zero to maximum range of feed rates.

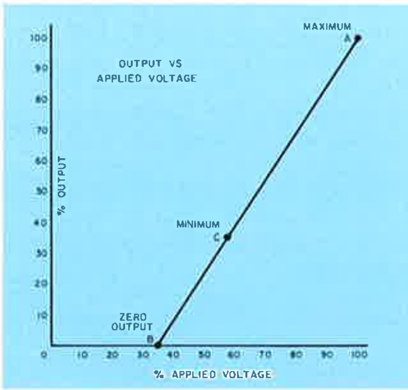



**Fig. 44:** Shows the "linearity" of the Kinergy Drive System over its "zero to maximum" range of outputs.

**Accuracy and Repeatability:** Anytime an SCR type of "Variable Voltage" controller is combined with a "source of intelligence" such as a load cell, nuclear scale, belt scale, or program computer with monitoring sensors, its output will automatically obey the command signal. Under these circumstances, the vibrating feeder's output will be about as qualitative as the source of its electrical signal. Accuracies of plus or minus 1% or even better are often achieved.

Otherwise, the accuracy and repeatability of the vibrating feeder's output at various voltage settings will most likely be plus or minus 5 to 10%.

**Typical Electrical Schemes:** The full zero to maximum range of feed rates permits many different electrical schemes. Some of them are:

**Pulsing:** This is the abrupt but temporary application of the maximum stroke and frequency to the feeder for a brief period of time on a repetitive basis. After the "pulse", the unit returns to the previously set or lesser output. This pulsing action permits vibrating feeders to also perform other functions such as "screening" in many applications.

**Max-Min Outputs:** The "maximum" output of the feeder is maintained for a given period of time. Then it shifts to a much lower output to accomplish the so-called "trimming". "Max-Min" types of control schemes usually fill bags, containers, weigh hoppers, or the like.

**Simultaneous, Multi-Feeder Control:** This scheme of control permits the simultaneous adjustment of a group of vibrating feeders.

### Location of The Drive Assembly

Aside from the conveying trough assembly, the remainder of any vibrating feeder is essentially composed of the means for driving it.

The vibratory drive system can be located on the feeding trough's underside, on top of it, or on one end.

**Underside:** The drive system is installed down underneath the feeding trough (Figure 45). This is the preferred drive location for all Kinergy Driven Feeders.

**Fig. 45:** The underside drive arrangement is recommended for all Kinergy Driven Feeders.

**Top Drive:** The drive system is mounted above the feeding trough (Figure 46). While slightly more expensive, this drive arrangement allows the bottom of the feeder's conveying trough to be fully accessible for various discharge ports.

**Fig. 46:** The top drive configuration is used on this 5 ft. wide by 29 ft. long feeder.

**End Drive:** The drive system is mounted on either end of the vibrating feeder (Figure 47). It has the advantage of a "low profile" type of design which minimizes head room requirements. Sometimes the lengths of these units are limited because the drive springs are necessarily concentrated on one end.

**Fig. 47:** A feeder with an "end drive", which has a "low profile" and is dust-tight.

### Trough Configuration

Various trough configurations are available. They can be rectangular with 90° corners or rounded. Tubular, partitioned, or other design configurations are available to better adapt the feeder to the application.

### Abrasion

Abrasive wear from "sliding" needs to be differentiated from abrasion caused by "impacting".

As a material is being conveyed, minimal sliding abrasion takes place because of the gentle "pitch and catch" action of vibratory movement. This is the reason vibrating feeders are preferred when very abrasive materials are to be fed.

Impact abrasion occurs when the incoming material strikes an exposed surface. When this repeatedly happens, the wear will be considerable. This is why liners are used at the inlets of some feeders. To minimize this type of abrasion, the material's vertical free fall can be decreased by allowing it to slide down a chute or have it impact on its own particles as is cleverly done with the so-called "rock box".

### Liners

The conveying troughs of the feeder can be lined with "abrasion resistant" (A.R.) plate or other alloys such as stainless steel. Ceramic brick, rubber, polyurethane UHMW, or the like are also available.

When the liners are made of metal, they are always recommended to be "plug" welded through relatively small holes as compared to being bolted. The life expectancy of the vibrating feeder is well beyond 20 years. Over this time period, a bolt holding a liner can come loose. When it does, the feeding trough is usually filled with material so it isn't readily accessible to maintenance personnel. Consequently, and as a practical solution, the flat heads of the bolts and the fastening nuts are eventually welded. When this is done, it is virtually the same as plug welding the liner initially, and therefore eliminating the need for any maintenance follow over the long term.

In most instances, and as a benefit of the gentle vibratory conveying action, the original metal liner will probably not be replaced over the life of the feeder because of "sliding" abrasive wear.

### Corrosion

If the material being fed is corrosive, the feeder's trough surfaces need to be properly protected. For instance, trough liners must be completely sealed. When corro-

# The Advantages of Kinergy Driven Vibrating Feeders

sion is coupled with sliding abrasion, the potential of the abrasive wear compounding the corrosive action needs to be taken into account. It would be the same as continually rubbing the rust off a corroded pipe. Therefore, when the material is both abrasive and corrosive, the latter dictates the trough construction or liner selection and not the former.

An example is feeding coal that has more than a 1% content of sulphur. If an "A.R." liner is used, it will appear to wear. Actually, the difficulty stems from the moisture in the coal combining with the sulphur to form a weak solution of sulfuric acid. This acid corrodes the surfaces of the A.R. Consequently, it rubs off very easily. Therefore, a stainless steel liner would be the correct choice because it eliminates the corrosion, and the hardness of its surface easily contends with the minimal sliding abrasion. This is the reason a thin stainless steel liner, say 1/8" thick, will not require replacement throughout the life of the feeder in many coal handling applications.

## Discharge Gates

For intermediate discharge ports, manual or air-operated gates can be provided. Usually they are of the moving slide, flip-flop, plunger, butterfly, or diverter type (Figure 48).

When used, these gates should almost always be mounted on the vibrating feeder's trough.

Other outlet configurations are available such as "side discharges", converging outlets, or vertical chutes.

## Pressure or Vacuum

When the internal pressure is 3 PSI or less, the dust-tight feeder design is basically used with adequate flexible connections.

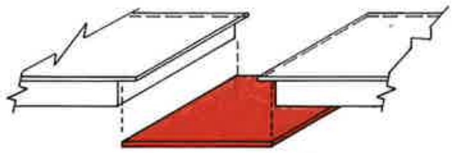
If the pressure is higher or a vacuum is required, the conveying trough usually becomes a "tube" with the appropriate end covers when the feeder is of the unidirectional type.

Circular feeder designs are usually more adaptable to pressures and vacuums.

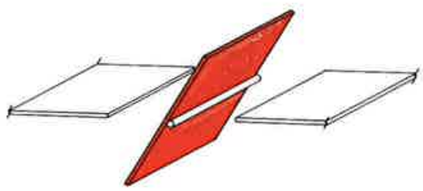
Most likely, bolted type flexible connections will be required.

## Ambient Temperatures

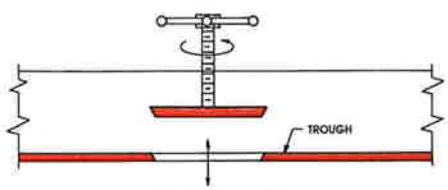
Kinergy Driven Feeders can operate in low or high ambient temperatures. Even so, the effects of these conditions on the material being moved should also be conscientiously taken into account.



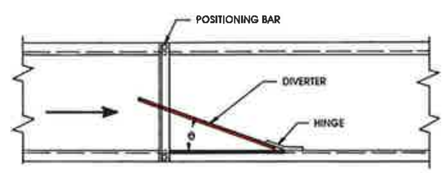
**A.** Removable Panel



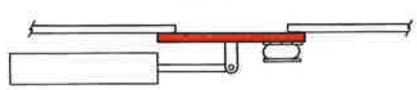
**B.** A "Flip Flop" Gate




**C.** Plunger Gate




**D.** Diverter



**E.** Slide gate with optional positioning.

**Fig. 48:** Some of the different types of discharge gates that can be used at the outlets of the vibrating feeder. Butterfly valves are not shown, but they can also be applied.

A popular use for these gates is when the fuel "distribution" function is being performed by a long feeder supplying equal amounts of it to the different feed points to the combustor of a boiler.

**Sub-Freezing Conditions:** Rubber isolators are avoided and "space heaters" may be required in the vibratory motor. The steel coil drive springs, fiberglass stabilizers, as well as steel coil isolators, would still be used. Units are in service where the ambient temperature drops to minus 50° F.

If the material entering the conveyor is already frozen, it will move without difficulty. Conversely, when it is not frozen and contains excess moisture or some water droplets are present, it will most likely "build up" a frozen or "iced" layer on the feeder's trough surface over a period of time. Therefore, if this freezing condition can't be avoided, an alternative method of feeding should be considered. Of course, the freezing temperature of the liquid could be decreased by adding, say, chemicals to it or the ambient temperature increased by heating the trough or installing the feeder in a heated building.

**Hot Temperatures:** By changing the stabilizers from fiberglass to flat metal bars and force cooling the vibratory motor, ambient temperatures to 450° F. can be endured by Kinergy Driven Feeders.

The anticipated material load needs to be reviewed to confirm the higher temperature will not have adverse effect that could detract from its conveyability.

## The Advantages of Kinergy Driven Feeders

The Kinergy Driven Feeder has a long list of advantages. For these reasons, there are thousands of them in daily productive use all around the world.

**Energy Efficiency:** The electrical power consumed by a Kinergy Driven Feeder will be less than any other type (Figure 49). To evaluate the reduced operating cost, multiply the difference in the horsepower needed to drive a competitive unit by $300.00 per year or an amount that is more appropriate for the area.

**Fig. 49:** Each of these three feeders supplies 800 TPH of minus 8" size limestone rock to secondary crushers in an aggregate plant. The power consumed per feeder is less than 2 HP! This "energy efficiency" reduces the "cost per ton" of rock produced.

Quite often, a "cash rebate" will be granted by the local electrical utility company for the use of a Kinergy Driven Feeder because it makes a marked reduction in the amount of power being consumed for a given feeding application.

# The Advantages of Kinergy Driven Vibrating Feeders (Continued)

**Repetitive Starts and Stops:** The rotating eccentric weights on the motor accelerate independently of the drive springs. Consequently, repetitive starts and stops are permissible. They can be up to five per minute without excessively over-heating the motor.

**Shock Loads, Load Variation, and Headload Capability:** The "sub-resonant" tuning and the "free force" input combine to make this possible.

**The Simple "Look and Listen" Maintenance Principle:** Just listen for any extraneous noise and check the unit's stroke. Other than greasing the motor about once every four months, that's all that is required for the proper maintenance of the feeder.

**Quiet, 80 dBA (or less) Operating Sound Level:** Any noise means something is wrong. Its source should be traced and eliminated. Usually, it will be found to be a loose bolt on one of the drive springs.

**Modern Design:** No other vibrating feeder has these added design improvements, so they should be noted. They are identified in Figure 50.

The stroke angle is 45 degrees when feeding capacity is the primary factor. While still being a gentle movement, it conveys the material faster. This enables more capacity per unit of width.

The drive springs are spread out and "distributed" across the feeder's width and along the length or around its circumference, instead of being "concentrated" in a single group. This enables easy access to any of the drive's components.

The isolation or mounting springs are located on the counterbalance and not the feeder's trough. This enables the feeder to be more readily and inexpensively supported from underneath, which is always recommended.

When the feeder is suspended, the suspension cables are attached to the feeder's trough. This permits the needed safety stops or the extra set of non-vibrating cables to be more readily rigged to the underside of the feeder. Sometimes electrical sensors at the support points may also be needed (Figure 51).

**Less Initial Cost:** Kinergy Driven Feeders are the least expensive to manufacture. Therefore, they are the greatest value for the least cost.

**Interchangeable Drive Components:** Quite often, the drive springs, stabilizers, and vibratory motor of the drive

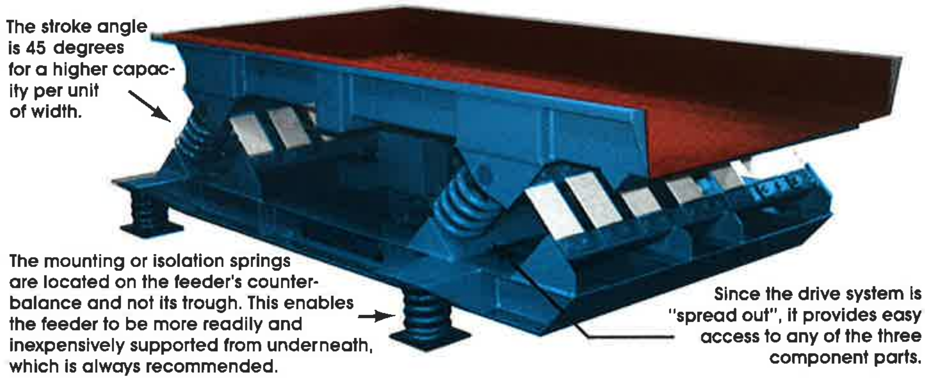



**Fig. 50:** No other vibrating feeder has these added design improvements, so they should be noted.

system would be interchangeable with other Kinergy Driven units installed at the same facility. This could include feeders, conveyors, screens, heat transfer units, spiral elevators, or the like.

Maintenance personnel like the commonality of the Kinergy Drive System on all their needed "Induced Conveying" machines.

**Optimum Range of Control:** This adjustable output feature is inherent in the Kinergy Drive System. Just add the "Variable Voltage" control at any time. The output can be adjusted from its "zero to maximum" output. This is the best range of control that can be obtained from any kind of feeder.

**Operating Versatility:** The feed rate can be coordinated with a computer monitoring the entire material handling system. The feeder will automatically slow down or speed up in response to its commands. If it's beneficial, the feeding unit can have its operating stroke and frequency automatically pulsed. This is used to minimize adhesion to the conveying trough. It can permit the feeder to also perform, say, a screening function.

**Few Drive Components:** Only three components make up the Kinergy Drive System. They consist of flat bar type stabilizers, steel coil drive springs, and the vibratory motor. On some light weight sanitary designs, even the steel coil drive springs are omitted.

Any of these components can be

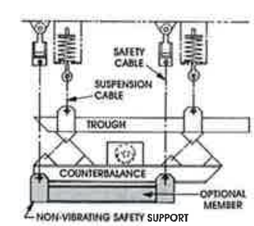



**Fig. 51:** When any Kinergy Driven Feeder is suspension mounted, the cables usually attach to the unit's trough.

changed in less than one hour by two mechanics possessing reasonable skills. This minimizes any down time in that regard.

**Reducing Wear:** The linear stroke accomplishes this benefit because this kind of vibratory action reduces the "sliding" abrasive wear.

**Easy Start-Up:** Each vibrating feeder is factory tested in the "no load" condition prior to shipment. Aside from confirming the motor's rotation at start-up, usually nothing further needs to be done. If, by chance, mechanical tuning is required, it only amounts to adjusting the motor's rotating eccentric weight and the bolted tuning plates, or possibly adding or subtracting a drive spring if the machine is very heavy or of a larger size (Figure 52).

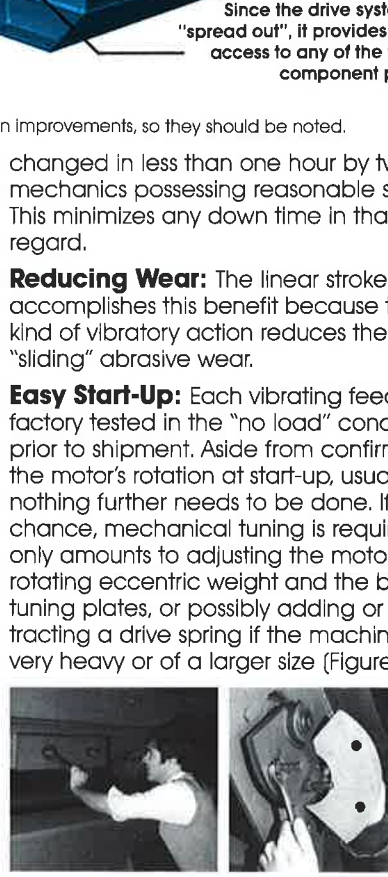


**Fig. 52:** If mechanical adjustments at "start-up" are needed, they are easy to do. The bolting of "tuning plates" to the counterbalance or adding eccentric weights to the motor is readily accomplished.

**Simply the Best:** With no more than three component parts, the design of the drive system is about as "simple" as it can be. The use of the most appropriate stroke angle for the application, smooth and quiet operation with only minimal maintenance, less abrasive wear, the optimum range of feed rates which also enables "pulsing", and the highest degree of energy efficiency combine to assure the "best" performance level.

Coupling this "simple" design with the "best" performance makes the Kinergy Driven Vibrating Feeder **"simply the best".**

# Sanitary Feeders

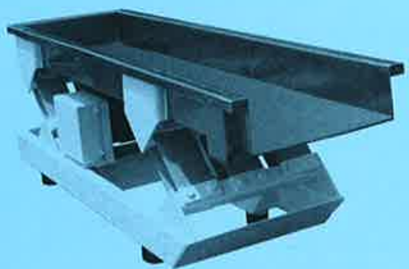
## Ammunition/Cosmetics/ Food/Pharmaceutical

In addition to taking advantage of the "self-cleaning" feature, many times the feeder needs to be of a "sanitary" design. The entire unit has a smooth and plain appearance and it is essentially free of dirt collecting pockets or crevices. The complete unit can be "washed" down with a water hose and none of the component parts are adversely affected. This includes the TENV motor.

Virtually any internal or external finish can be provided. The welds can be "power tool cleaned", "ground smooth but not flush", or "ground smooth and flush" with a polished uniform stripe with a specified grit, such as No. 150. The surfaces can be hand polished to, say, a No. 4 finish. So-called "Dairy" finishes or the 3-A sanitary designs which combine the USDA, the manufacturer, and the end user, can also be provided.

When they are objectionable, the steel coil drive springs are omitted and flat bar type springs are used to serve that purpose. Sometimes solid rubber isolators are required and they replace the steel coil compression springs that are normally used.

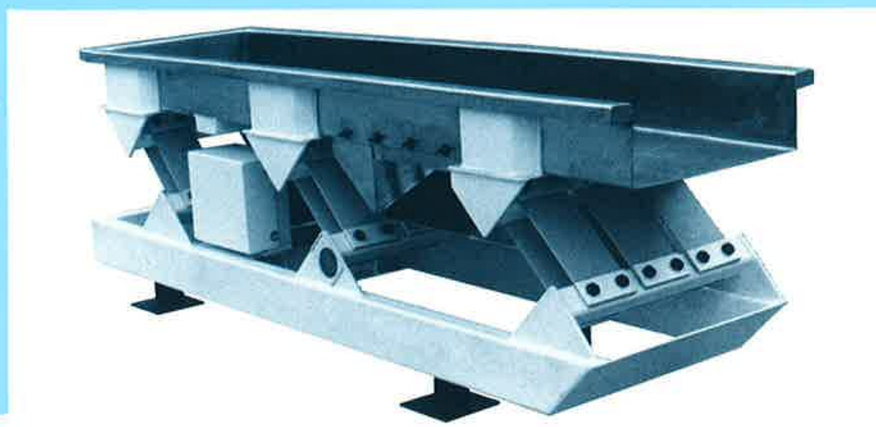
The unit's paint coating will most likely be "FDA" approved or some other particular type. Conveyors with sanitary designs are used routinely in ammunition, cosmetic, food, or pharmaceutical processes. They will normally be of the "Light Duty" type, but occasionally, a "Standard" or even a "Heavy" Duty rating may be needed. By adding a "Variable Voltage" controller, the unit's feed rate can be adjusted.

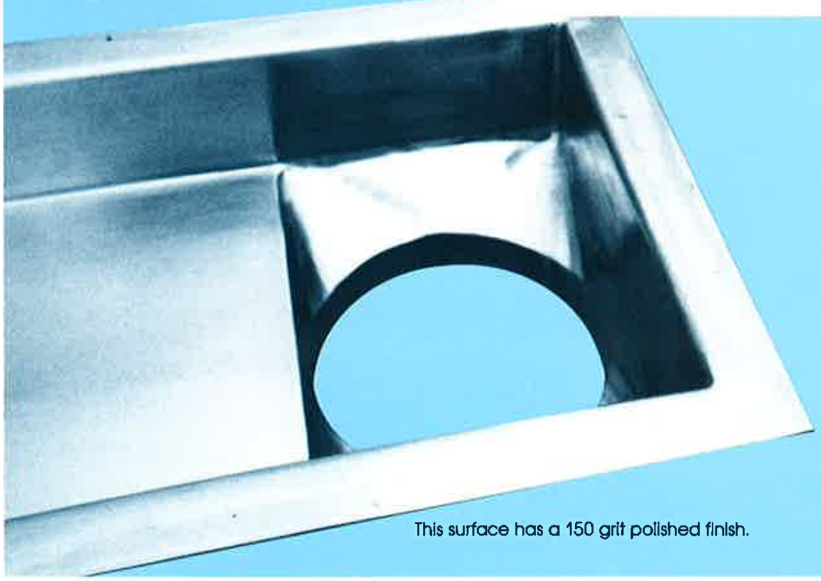


Flat bar drive springs and solid rubber isolators are utilized on this feeder.

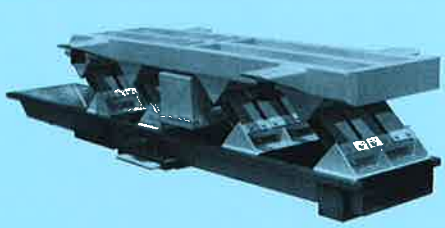
Note the solid rubber isolators.

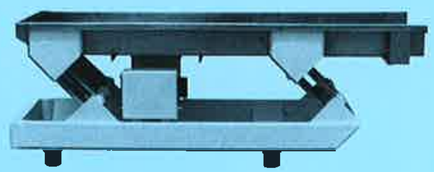
This inclined unit drains liquid out the back end. The trough's steel is "stippled".





This surface has a 150 grit polished finish.





# Light Duty Feeders

Primarily designed for use in the Feed, Seed, and Grain Industries, these Kinergy Driven Feeders can be applied for moving materials to a density of about 30 PCF.

When it is needed, they can be made with smooth lines and essentially free of dirt collecting pockets and crevices. The complete unit can be "washed down" with a water hose without adversely affecting the unit's components. This includes the TENV motor.

If it is wanted, fiberglass flat bar type drive springs combined with solid rubber isolators can be supplied. Otherwise, steel coil springs for driving and mounting the unit will be provided. "Dust-tight" troughs are available.

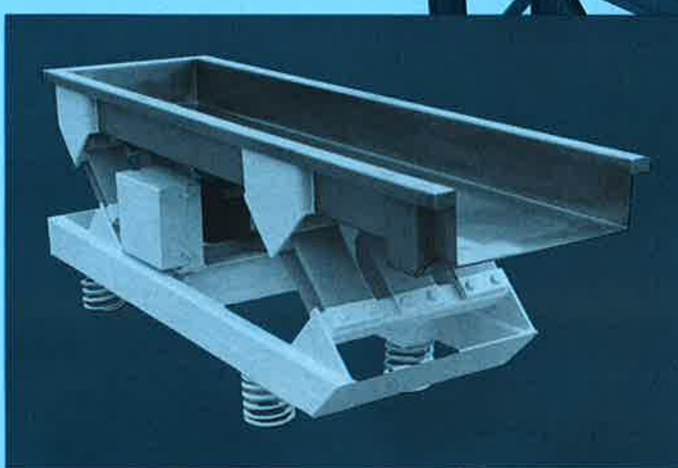
Available in widths from 2 to 72 inches, in the needed length, the 4 to 6 inch deep troughs of these economical conveyors are normally constructed of No. 12 to 7 gauge mild steel or any one of the alloy steels, such as "stainless". They normally operate at 570 CPM with a stroke of 5/8 of an inch.

By adding a "Variable Voltage" controller, the unit's feed rate can be adjusted.

"Dust-tight" trough. It will be supported by suspension cables.

This unit has a trough section of fiberglass to facilitate the use of an electro-magnet above it to remove unwanted ferrous metal.

Dust-tight trough with the drive system on one end.



# Standard Duty Feeders

Apply these units for conveying aluminum cans, chemicals, metal stampings or turnings, plastics, wood scraps, wood chips, sugar, or similar materials that have a density to 50 PCF.

The standard trough widths range from 12 to 96 inches with the lengths as required. The depth is 8 inches. Trough construction will be 1/8" to 5/16" thick mild steel or one of the alloy steels, including "stainless". Any suitable liner is available and they can be supplied with "dust-tight" feeding troughs with the proper inlet and outlet flexible connections.

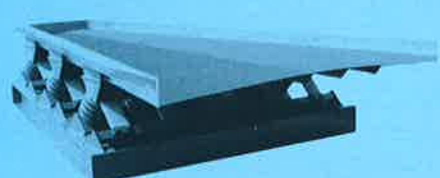
The steel coil drive springs, which are guided by the fiberglass stabilizers, combine with the enclosed motor to power the conveyor. They usually operate at 855 CPM with a stroke of 5/16 of an inch at a 45 degree angle.

By adding a "Variable Voltage" controller, the unit's conveying speed can be adjusted.

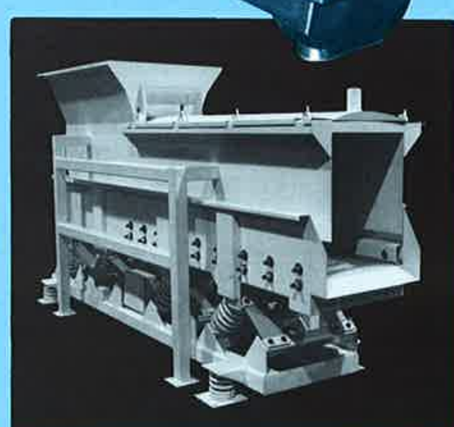
The trough design of this integral "dump hopper" feeder interfaces nearly perfectly with rotating drum like units, such as trommel screens, rotary kilns, or shakeouts.

This "end drive" was necessarily of a special design.

"Dust-tight" trough. Support will be from above by suspension cables.



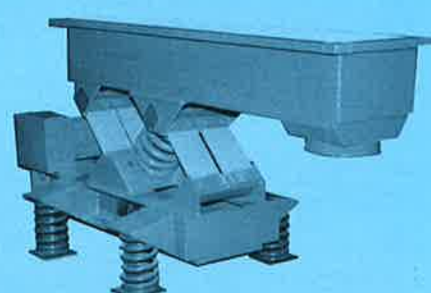
A "Spreading" Feeder.



A screening feeder with a dump hopper.

Tubular units don't convey the material as fast as flat surfaces, but the cylindrical shape lends itself to pressure or vacuum ratings. When those ratings are needed, the flat plates bolted to the end flanges will change.

The projecting "pins" on this unit are for the mounting of heat insulation which is to be added in the field.



# Heavy Duty Feeders

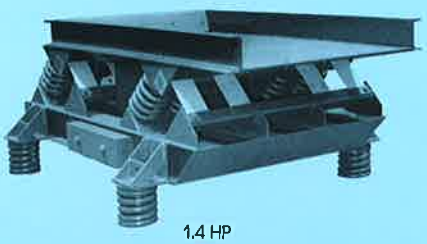
This is the most popular Kinergy Driven˙ Feeder. Originally designed for the mining industry to feed crushed ores, all sizes of coal, and crushed rock, its application has expanded to the handling of wood chips, scrap metal, municipal solid waste (MSW), refuse derived fuels (RDF), wood logs, and similar materials.

Available in trough widths from 12 inches to 12 feet and 8 inches deep, their lengths are as required. Conventional or "dust-tight" trough designs can be provided. When low head room "dump hoppers" are wanted, they can be made an integral part of the feeder if it is advantageous to do so.

They usually operate at 855 CPM with $^3/_8$ of an inch stroke that is at a 45 degree angle when capacity is the primary factor.

They can feed "any size" material to 65 PCF density. When the density is 70 to 120 PCF, the maximum "size" of the material is usually limited to minus 8 inches.

1.4 HP



1.4 HP

2 HP

The older feeder design configuration, with all the drive components "concentrated" in one location and its support from the trough, is still available at a slightly higher cost. Their lengths are limited to about 8 feet for structural reasons.

A typical Aluminum Dross Feeder.

10 feet wide by 23 feet long, 10 HP.

Sealed discharges are preferred to be vertical. Sometimes they are horizontal as shown here. They can accumulate "fines" in the lower portion of the flexible connection over the long term.

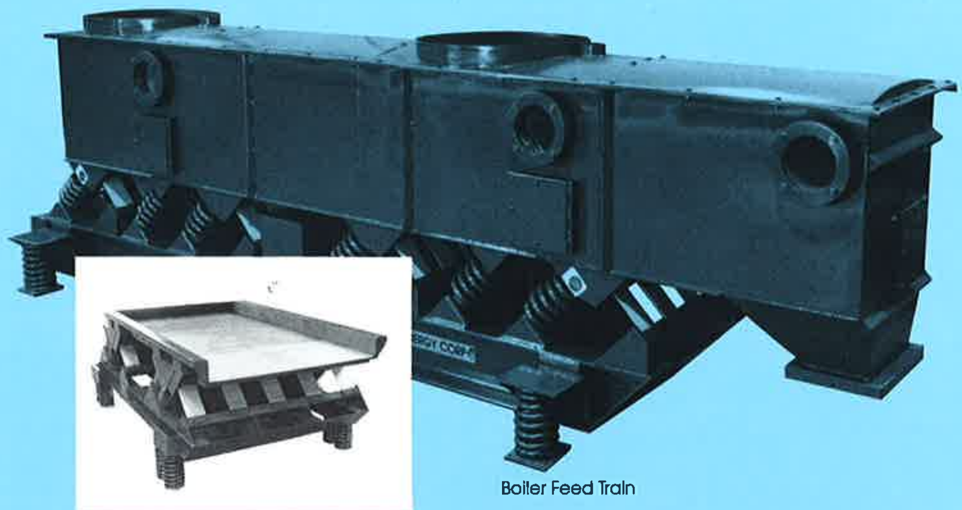
18 inches wide with UHMW liner.


Grizzly bars are added at the discharge end for scalp type screening. 2 HP.

The trough can be "formed" or made with structural side channels. Either one is 8 inches deep as a standard.

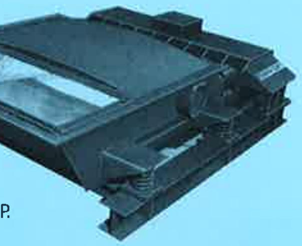
Integral Dump Hopper

Dust-tight trough. 5 HP.

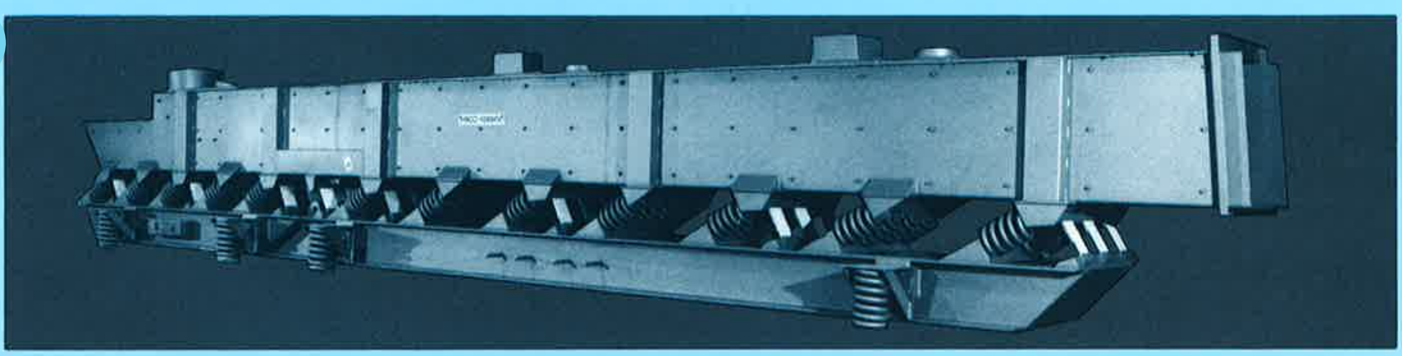


Boiler Feed Train

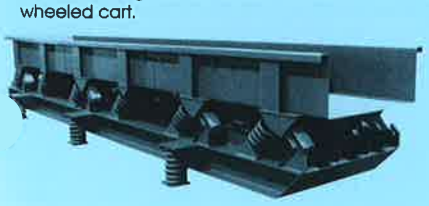
Dust-tight trough



End drive,
low profile. 2 HP.



A "batch" weigh feeder which is mounted on a rail wheeled cart.



A feeder that also "screens".

Integral dump hopper. Note the cantilevered trough at the discharge end.

The inlet of this large feeder is kept full by an "Activated Bin" mounted above it. "RDF" or wood waste, or any combination thereof, is split into three feed streams and supplied to outlets spaced along its length. The result is all the feed points of the combustor of a boiler are automatically provided with an adequate amount of fuel even though its physical properties and heat content are continuously and simultaneously varying. The power required is 6 HP. It has a "top drive" arrangement to make the trough bottom available for outlets equipped with air-operated gates.

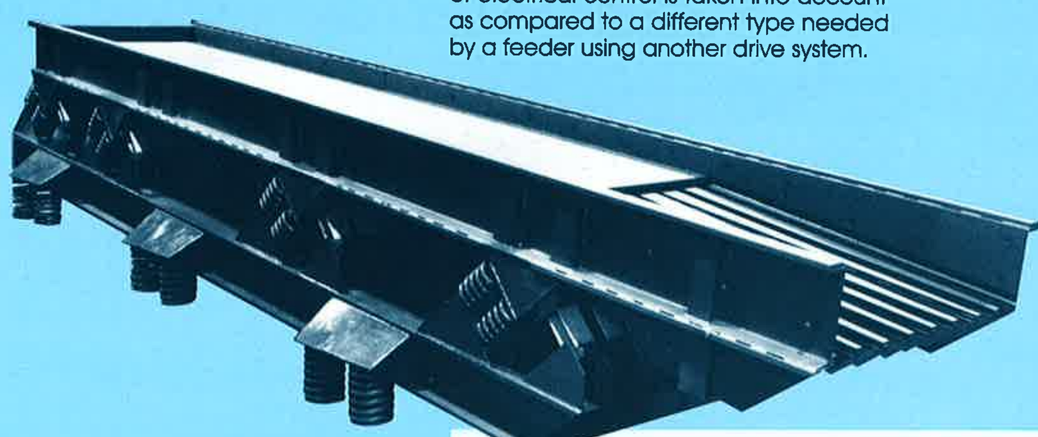
# Extra Heavy Duty Feeders

These are the most "rough and tough" vibrating feeders. They are normally applied when heavy materials are to be fed and this higher density is combined with large "sizes" that are typically expressed in "feet" instead of "inches". Their most popular application is as a "Primary Crusher Feeder" in a rock quarry or as a "Cupola Feeder" of scrap metal chunks in a Foundry. Sometimes they make up a huge "flat floor" under a dump hopper to achieve the most volumetric storage space in the least amount of height.

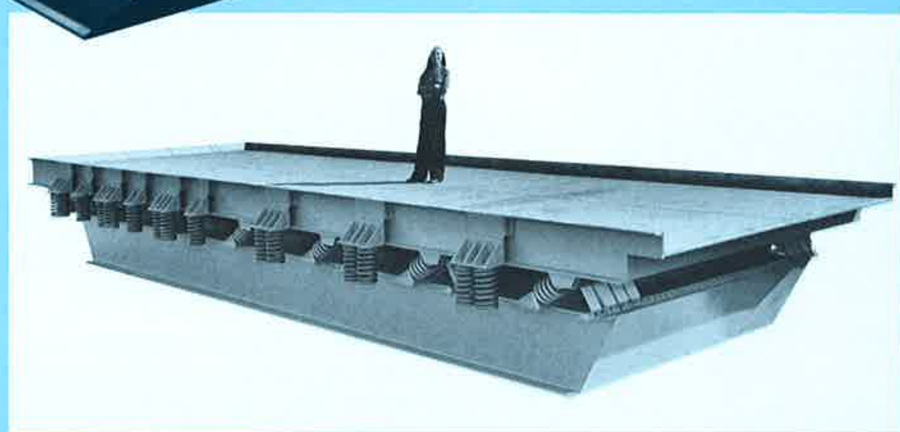
Widths are 3 to 12 feet as a standard and the length is as required. Since these feeders are almost always subjected to abusive loading, they are recommended to be supported on steel coil compression springs mounted on an undersupporting structure.

They usually operate at a frequency of 855 CPM with a 45 degree linear stroke to 3/8 of an inch.

When comparing these feeders to other units, note the reduction in overall cost when the "Variable Voltage" method of electrical control is taken into account as compared to a different type needed by a feeder using another drive system.



When Primary Crusher Feeders require an efficient level of screening, the required "screen area" must be available to accomplish it. This unit is 54 inches wide by 27 feet long with a 10 HP input.



**The "Kinergy King"**
The world's largest vibrating feeder.
It is 12 feet wide by 38 feet long and consumes 10 HP.
To reduce the head room requirements of a "dump hopper", it makes up its "flat floor".

# ► Circular Feeders

# ► Method of Support

## Circular Feeders

All circular feeders are supplied with the drive system on the bottom (preferred), top, or around the vertical side wall periphery. They all develop a helical stroke pattern. Depending upon the application, the linear stroke angle around the circumference of the unit will vary from shallow to being very steep. They should be used when a unidirectional advancement is not wanted, there is limited space for the feeder, or this type of storage means and feeding scheme is more appropriate for the application (Figures 53 and 54).

Of course, all circular feeders have the full range of adjustable output, zero to maximum, by the same simple method of electrical control.

**Fig. 53:** Looking down on a circular feeder. The incoming material is received and stored in the center portion. It conveys in a circular path and gradually moves outward. By moving up the peripheral track, it is fed out near the top of the unit through a tangential discharge chute.

**Fig. 54:** A circular feeder as seen from the side. Note its cylindrical shape.

## Method of Support

All Kinergy Driven Feeders are purposely designed to be easily and inexpensively supported from underneath. This enables the feeder to contend with a high shock or impact loading whether it is anticipated or it becomes an "unexpected" reality. Another benefit is the inlet of the feeder remains aligned with the outlet of the bin, silo, or storage pile above as it changes from being empty to a full load condition. It also relieves the necessity of repeated inspections of the feeder's support, performing added maintenance work, and the potential requirement of electrical sensing devices.

When they must be supported from above, they are suspended from the feeder's trough. Safety stops or a second set of non-vibrating cables is always recommended. Electrical sensors may also be needed.

Since Light Duty and Standard Duty vibrating feeders are not handling very heavy materials, it is more practical to support them by an overhead suspension. Heavy duty feeders of a narrow width are matched with a relatively small opening in the storage means above, so their mounting by cables is more reasonably prudent.

**Conversely, the wider heavy duty units and virtually all the extra-heavy duty feeders are recommended to be supported from underneath.** This is so even though they are supposed to have a "steady state" loading by being installed under a bin, silo, or storage pile. Recognizing these ruggedly built feeders handle the more dense materials, here are some of the reasons:

### High impact or shock loading can still occasionally and repeatedly occur, as was concluded by more than 30 years of experience in the field follow of vibrating feeders.

Examples would be the failure of a wide spanning "bridge" that temporarily formed in the storage means above, and massive amounts of material fall down (Figure 55). Another is the eventual collapsing of a gaping core or "rat-hole" in the bin, silo, or pile (Figure 56). With the latter, front-bladed vehicles pushing large amounts of material into cores or rat-holes has similar consequences (Figure 57). These are unforeseen practical situations that can occur over the life of the feeder, which is designed to be longer

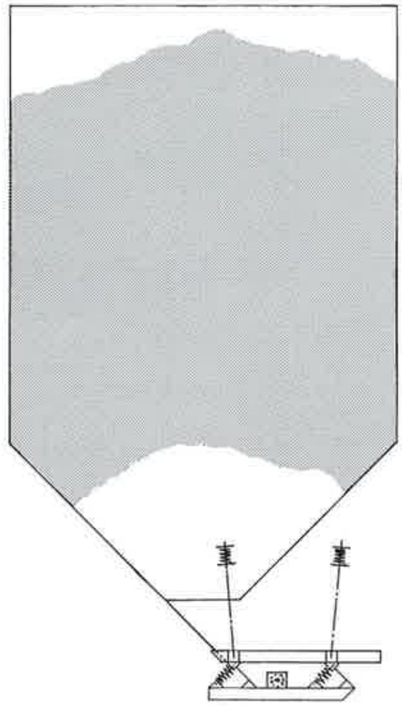


**Fig. 55:** A temporary bridge in the bin or silo above the feeder can ultimately be broken or fail. When it does, tons of stored materials can fall and slam into the feeder installed at the outlet. This is called an "unexpected" impact loading.

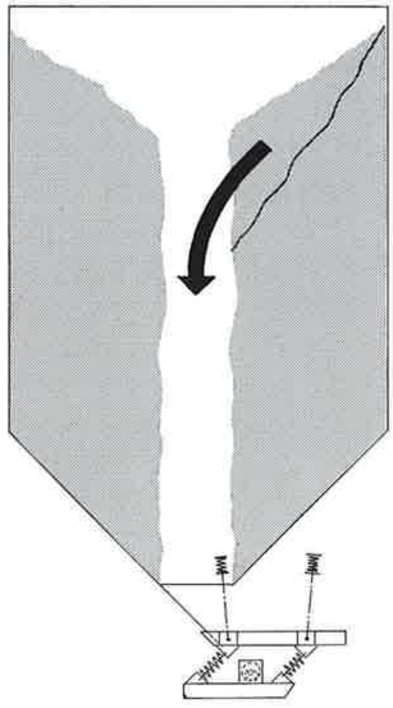


**Fig. 56:** A "core" or "rat-hole" could eventually collapse and cause massive amounts of material to impact against the unsuspecting feeder below.

# Method of Support (Continued)

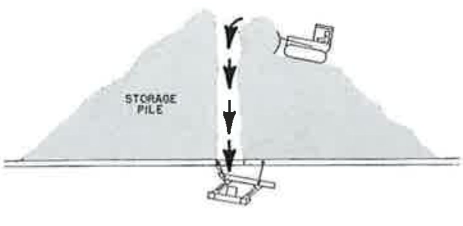



**Fig. 57:** Storage piles that don't have ground level openings that are based upon the stored material's "critical core" dimension will most likely "rat-hole". When they do, a front-bladed vehicle repeatedly pushes the peripheral material into the big opening at the top of the pile. Consequently, the feeder must endure the resulting dynamic loading.

than 20 years. The resulting and repetitive impact pounding on what is probably an empty feeder below plays havoc with any cable suspension over the long term.

**Since Kinergy Driven Feeders can tolerate more headload, larger outlets are being used.** For example, the bin "throat" or length can be longer. This bigger opening generates a greater impact force by the falling material if it should ever happen. This is further compounded by the increased width of the feeders now available.

**If a unidirectional feeder is vertically suspended, it will innately swing backward when it is vibrated under full load.** The feeder's suspension is seeking the point of force equilibrium as a result of the material's flow. Once it moves backward, it will remain there until the loaded condition has been relieved (Figure 58). The more shallow the stroke angle, the further the feeder is declined, and the heavier the stored material, the greater the movement to the rear will be. This shifted distance actually changes the planned "interface" of the feeder with respect to the outlet of the storage means above. The outlet and the feeder's inlet are no longer aligned, and the effective length of the feeder's trough has also been reduced.

When the feeder is undersupported on compression springs, they oppose the feeder's lateral movement. Therefore, the feeder's position is laterally stabilized. Consequently the feeder essentially retains its pre-planned position as it changes from the "no load" to the "full load" condition.

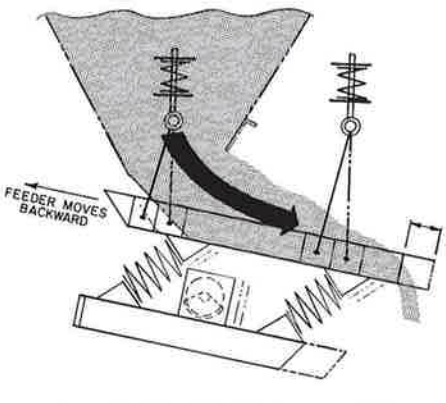



**Fig. 58:** A unidirectional feeder that is vertically suspended will inherently shift backwards when it changes from being "empty" to the condition of a full load, and the material is being fed.

**Consultants qualified in "Static Design" technology for bins, silos, and storage piles necessarily specify steep side walls slopes and larger outlets** to prevent the stored material from bridging. Consequently, the feeder's width is increased to match the opening. If, by chance, the feeder was to fall and leave the large opening unobstructed, the consequences could be catastrophic. For example, the stored material could gush out so fast that a partial vacuum is created in the silo above. When this happens, the silo would be severely damaged or it might even collapse (Figure 59).

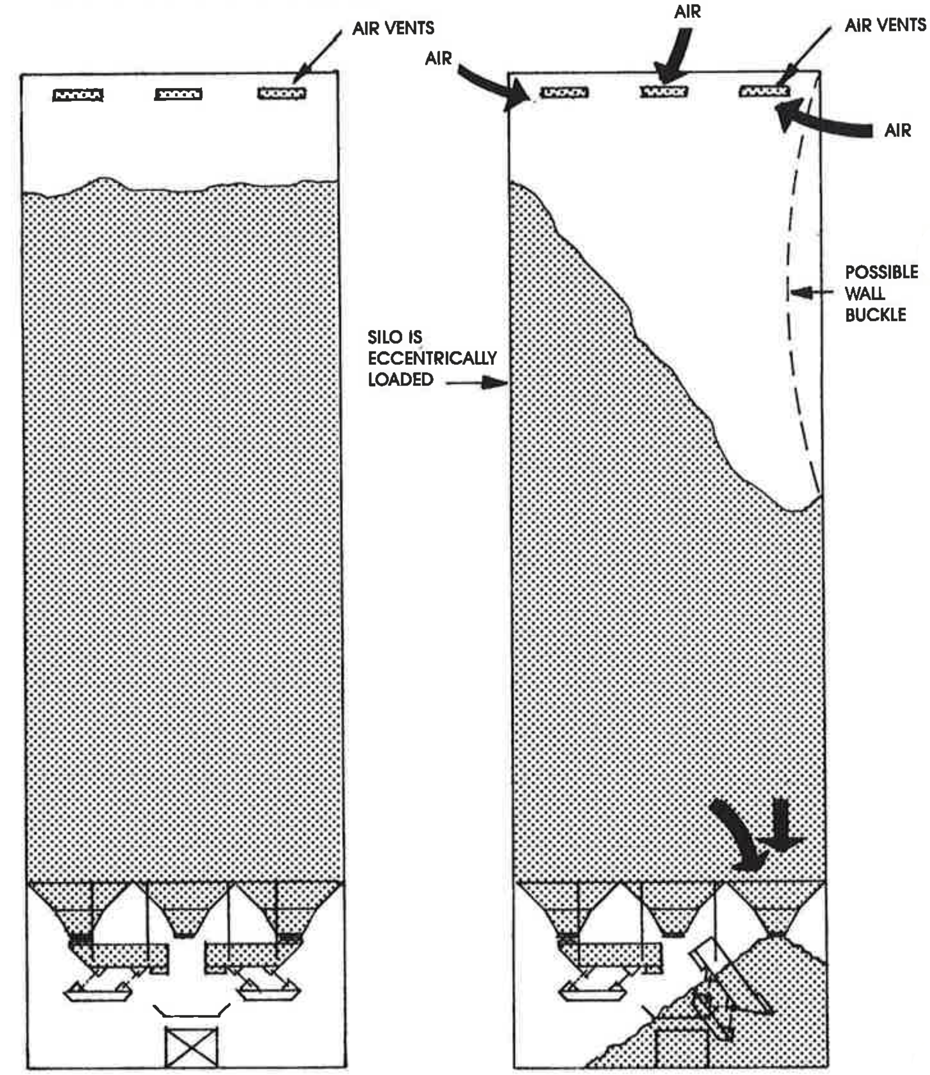



**Fig. 59:** If the vibrating feeder should ever fall and leave a large outlet unobstructed, the stored material could flow out so fast that it causes a partial vacuum to form in the silo above because air can't enter quickly enough to refill the vacated space. When that happens, the silo could be severely damaged or may completely collapse.

# ▶ Testing
# ▶ References

**If the stored material can take a "set", it will solidify when it is not being fed.** A feeder operated on a varying time schedule would be a potential for this situation. Keep in mind, non-flowing conditions can occur over the week-end, during holidays, or with the time lost by an inadvertent shut down. To break the material's consolidation, a large shocking force is typically used, such as a blast of high pressure air. When this "flow assist" device is successful in shattering the stored material's "set" condition, the odds are the feeder below will be subjected to a strong impact force caused by the falling material.

**The suspension cable connections will innately wear and they could become corroded,** but their deterioration may not be noticed by maintenance personnel. This is the reason safety stops or a second set of non-vibrating cables is always recommended. If a cable support point does fail and the feeder engages the safety suspension, it most likely will still continue to vibrate because the plant personnel are not yet aware of the failure. The feeder's continued operation under these circumstances in some installations could be disastrous.

**When the load on each of the cables is not uniform, they can laterally vibrate or "whip".** This whipping causes their connecting hardware to accelerate its wear. This can happen even though they were properly tensioned previously. Cables are made of stranded wire which means they can stretch. Particularly if a given point of support absorbed the brunt of an unexpected shock loading at some time during its use. This situation is aggravated when a cable suspension that is intended to be vertical actually is installed "askew" or tilted outboard.

If a suspension point fails, usually the cables are intact. Instead, the shearing of a bolting type fastener at one of its linkages is the typical cause of the failure.

**Suspending large feeders from bin or silo transitions adds stresses at their upper connections.** This is usually at the "break line" of the bin or silo. In this situation, the feeder is probably close to the floor level below it. Therefore, it most likely could be supported by a steel structure from that floor and ease the stresses at one of the most vulnerable structural joints of a bin or silo, which is at its "break line".

**Conclusion:** Taking into account all these practical possibilities that could occur with these larger and more heavily loaded feeders, it should be understandable why Kinergy always recommends they be supported from underneath. Years and years of usage have proven the undersupporting method is much better and more reliable over the long term than suspension cables. This is accomplished with virtually no maintenance being required. When repetitive, high shock or impact loading is "known" to be anticipated, there virtually isn't any choice.

This is one of the basic reasons why all Kinergy Driven Feeders are purposely designed to be easily supported from underneath. **In most applications, the cost of the undersupporting structure is about the same as the total expense for the overhead type.** Particularly, if electrical sensors with their added wiring are also required.

## Testing

For most vibrating applications, testing is not required. The years of experience in applying these units makes this possible. All the details of the application need to be clearly and fully stated so the appropriate unit can be recommended.

When testing is required, Kinergy has the facilities to conduct it. For evaluation at the site of use, feeders are available for testing as a rental unit.

## References

A "vibratory machine" is any unit intentionally or purposely vibrated in order for it to perform useful work or some beneficial function. This intentional use of vibratory power by the engineers applying and designing these machines clearly separates them from those who do precisely the opposite which is to ardently strive to minimize or eliminate vibrations.

"Induced Conveying" units primarily depend upon the generated vibratory action to move the material load. This factor differentiates them from the "Induced Vertical Flow" group of vibratory machines which all have the forces of gravity as the prime mover of the contained material.

To further qualify or substantiate this text, the following references are cited:

1. To determine capacities (TPH) and the recommended interface for a given application, please see Bulletin IL-KDF entitled "Interfacing Vibrating Feeders" of the unidirectional type.

2. The "Variable Voltage" type of controller for any Kinergy Driven unit is further described in Bulletin ES-KD-1 entitled "Electrical Control Characteristics and Schematics".

3. To better understand the behavior of bulk solids in the various means for storage, the following should be of assistance:

(a) "The Induced Vertical Flow of Bins and Silos", which is technical bulletin "IVF-Bins & Silos".

(b) "The Combined Port Concept for Achieving Expanded Flow Patterns from Storage Piles". This technical paper will help in the dimensioning and the layout of ground level openings.

4. For more about Boiler Feed Circuits, consult the article: "Storing and Discharging, Distributing and Feeding 'Waste Type Fuels' to the Combustors of Boilers", 1991.

5. For a more detailed explanation of the Kinergy Drive System, please see Bulletin KDB-1, which also shows it applied to all of the other "Induced Conveying" machines. Attention is called to the included chart which candidly compares the various kinds of vibratory drives available.

6. For an explanation of how and when the various types of vibratory drive systems were developed and their respective characteristics, please refer to the technical paper entitled "The Evolution of the First 'Universal' Vibratory Drive System for Moving and Processing Bulk Solid Materials", 1984.

7. For "How to Analyze Any Vibratory Machine", please see "Power Analysis Reveals a 'Common' Drive for Vibrating Equipment", International CHISA Conference, Prague, Czechoslovakia, 1987.

The text of this bulletin is intended to be professionally informative. Any suggestions or constructive criticism to improve it are invited. Please write:

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# Typical Applications

## Typical Applications

Kinergy Driven circular or unidirectional vibrating feeders have been successfully applied for the feeding of Flake, Floodable, or General type bulk solids and various "unit pieces". These applications include the following:

**Aggregate Industry:** Primary crusher feeders (Figure 60), secondary crusher feeders (Figure 61), and the reclaim feeders for limestone or granite rock (Figure 62) are the usual applications.

The 30 ton truck backs up to dump.

The Kinergy Driven Primary Crusher Feeder with a 5 HP input.

The fed rock just before it goes into the crusher at a rate of 450 TPH.

The feeder before it was installed. It is 4 ft. by 17 ft.

**Fig. 60:** After the rock has been quarried, the first step is to "dump" it into a "primary crusher feeder". The large rock with boulders is crushed to about a 6 or 8 inch size.

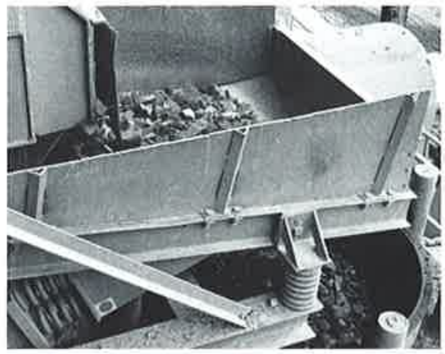


**Fig. 61:** Feeding secondary crushers at 600 TPH and consuming less than 2 HP.

**Fig. 62:** Crushed rock being "reclaimed" from a storage pile above. The feeder is 36 inches wide by 7 feet long and it feeds 400 TPH, but only consumes 1.4 HP.

The energy efficiency and minimal maintenance of Kinergy Driven Feeders combine to reduce the "cost per ton" of rock produced. This is why there are so many Kinergy Driven Feeders installed in rock quarries.

**Boiler Feed Trains:** By combining the principle of "Induced Vertical Flow" with that of "Induced Conveying", which has the optimum range of feed rates, and taking advantage of the amazing speed of a computer monitoring the combustion process, the various types of "waste fuels" can be successfully fed to the combustor of a boiler. This is so even though the fuel's physical properties and its amount of heat content are continuously and simultaneously varying (Figure 63).

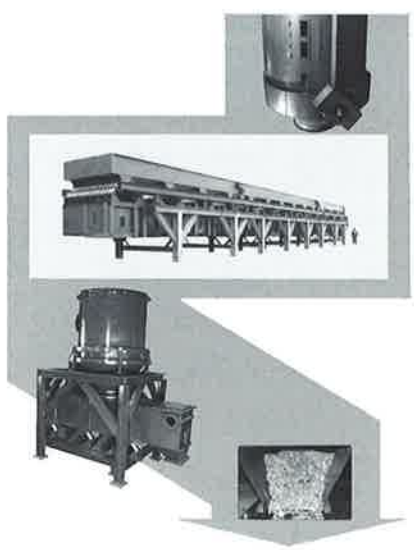
**Cement Plants:** Feeding the stored raw material on the upstream end of the cement making process.

Clinker is also fed by vibrating feeder because they are subjected to less abrasive wear.

**Ceramic Industry:** The highly abrasive materials are fed without excessive wear.

**Chemical Plants:** Feeding the various chemicals without causing degradation or attrition to any delicate particles.

**Coal Handling:** The feeding of coal is one of the most popular applications for heavy duty units (Figures 64, 65 and 66).



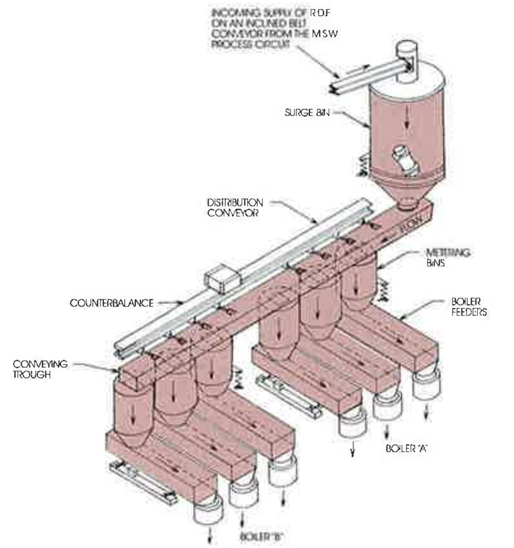



**Fig. 63: Storing, Distributing, and Feeding Waste Type Fuels to a Boiler**
By combining the principle of "Induced Vertical Flow" with that of "Induced Conveying", which has the optimum range of feed rates, and taking advantage of the amazing speed of a computer monitoring the combustion process, the various types of "waste fuels" can be successfully fed to the combustor of a boiler. This is so even though the fuel's physical properties and its amount of heat content are continuously and simultaneously varying.

Protected by Patent Nos. 4,774,893 4,899,669 4,844,289. Other Applications Pending.

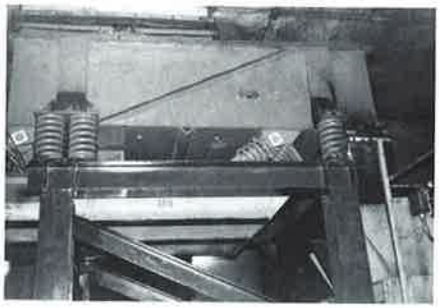
**Fig. 64** When discharging coal or any other stored material from large bins or silos, the vertical flow pattern inside needs to be uniformly symmetrical and concentric. If it's not and it is "off center", the eccentric loading on the bin or silo could cause structural damage.

They almost always have multiple outlets. When they do, the center feeder is always discharging. The peripheral feeders around it are operated on a proper time sequence so the coal's vertical flow essentially drops its top layers uniformly, or much like water.

Each of these seven feeders is "dust-tight", supported from underneath, and consumes less than 2 HP delivering 250 TPH of coal.

Three 70 ft. diameter by 180 ft. high coal silos.

Looking down at the seven outlets in each of the silos. A belt conveyor passes under the three that are horizontally aligned in the picture.



The "short length" feeder under each of the three outlets in line with the belt conveyor. One of them is the center feeder.

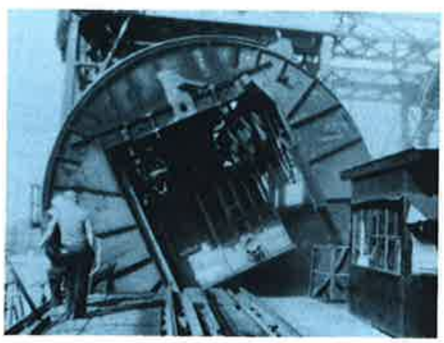
One of the four longer feeders that feeds the peripheral coal to the belt conveyor.

**Fig. 65:** This horizontal mounted feeder is 4 ft. wide by 12 ft. long. It has a screening deck to remove minus 1" size coal. The rate is 250 TPH and the power needed is 2 HP.

**Fig. 66:** Coal is being unloaded by means of a "rotary car dumper". The 100 ton loads drop down into two 10 ft. wide by 23 ft. long feeders that are conveying the coal towards one another and discharge it onto the same belt conveyor.

The large feeders make up the "flat floor" of the two dump hoppers to minimize their height requirements. Each feeder delivers 1500 TPH of coal and consumes 10 HP.

The 100 ton rail car being brought up to the rotary car dumper.



The car is dumped by rolling it over.

The upstream end of one of the large feeders installed under the dump hopper.

A photo of the 10 ft. wide by 23 ft. long feeder before it was installed.

**Composting Facilities:** Vibrating feeders are utilized on the "tipping" floor for the incoming MSW.

**Crusher Manufacturers:** Often the vibrating feeder is supplied with the crusher. If it is wanted, the feeder can automatically maintain a constant crushing load.

**Food Processors:** Sanitary designed feeders are used by the canners of fruits and vegetables. Cereal manufacturers and meat producers have various feeding needs. These units will most likely require sanitary designs with the appropriate surface finishes.

**Foundries:** Feeding scrap metal to the cupola or the sand to the molds.

**Glass Industry:** Feeding the raw material of the glass batch mix.

**Grain Processing Plants:** The very light weight, economical vibrating feeders are used to meter the respective grains.

**Grinders:** Feeding the abrasive materials needed for the making of grinding wheels, grinding paper, or abrasive saw blades.

**Material Recovery Facilities:** Vibrating feeders are used on the "tipping floor" which receives the incoming MSW.

When entangled wire is being recovered, Kinergy Driven Feeders are the best kind to use.

**Metal Recycling:** Feeding aluminum cans and scrap iron or steel is the needed function (Figure 67).

**Mineral Benefication Facilities:** Anytime a mineral such as coal, ore, rock, or the like is being handled, vibrating feeders will be utilized because of their abusive loading capability and minimal abrasive wear (Figure 68).

**Pasta Makers:** The gentle feeding of noodles, shells, spaghetti, macaroni, or the like.

**Pharmaceutical:** Feeding tablets and capsules. Polished surface finishes and sanitary designs will be required.

**Power Plants:** Feeding the fuel to belt conveyors located under the unloading or receiving station, reclaiming the fuel from a storage yard or silo, or supplying the fuel in a boiler feed circuit are all potential applications.

Vibrating feeders are sometimes needed in the handling of the bottom ash.

**Pulp & Paper Plants:** Feeding wood chips to the digester (Figure 69).

**Refuse Derived Fuel (RDF):** Dust-tight trough design vibrating feeders are one of the best methods for feeding RDF to a boiler. Their optimum range of feed rates and the nearly instantaneous response to the computer monitoring the fuel's combustion are the primary reasons for their success in this kind of use.

**Sand and Gravel Plants:** Vibrating feeders meter this material without abrasive wear.

**Shredding Operations:** Very often, a vibrating feeder supplies the shredder, and another one is used to move the shreddings out from under it.

**Wood Yards:** Accepting loader dumps of logs and feeding them into a "hog" or "chipper".

**Fig. 67:** Scrap metal being loaded into a feeder with an integral dump hopper. The unit uses 2 HP.

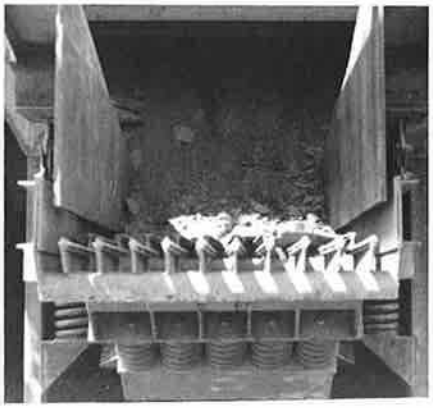


**Fig. 68:** Feeding gold ore at a rate of 300 TPH and needing 2 HP. The feeder is 66 inches wide by 10 ft. long and it has a grizzly bar screening section on the end.

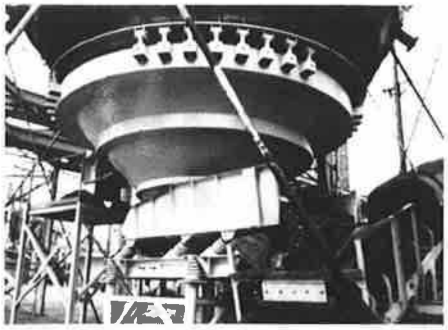


**Fig. 69:** Feeding wood chips to a belt conveyor that delivers them to a digester. Using 2 HP, the feeder is 6 ft. wide by 10 ft. long and it feeds at 250 TPH.

**Fig. 70:** This feeder with an intergral dump hopper is discharging onto a belt conveyor that is feeding a shredder. The material is scrap steel, the rate is 250 TPH, and the needed input is 2 HP.

**Fig. 71:** This 54 inch wide by 27 ft. long primary crusher feeder moves 650 TPH of boulders and rock. Its input is 10 HP.

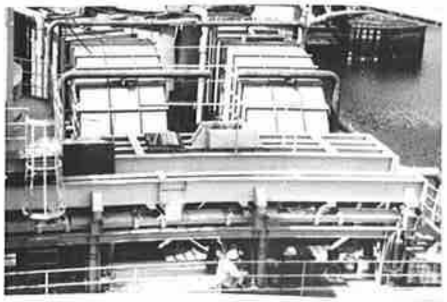
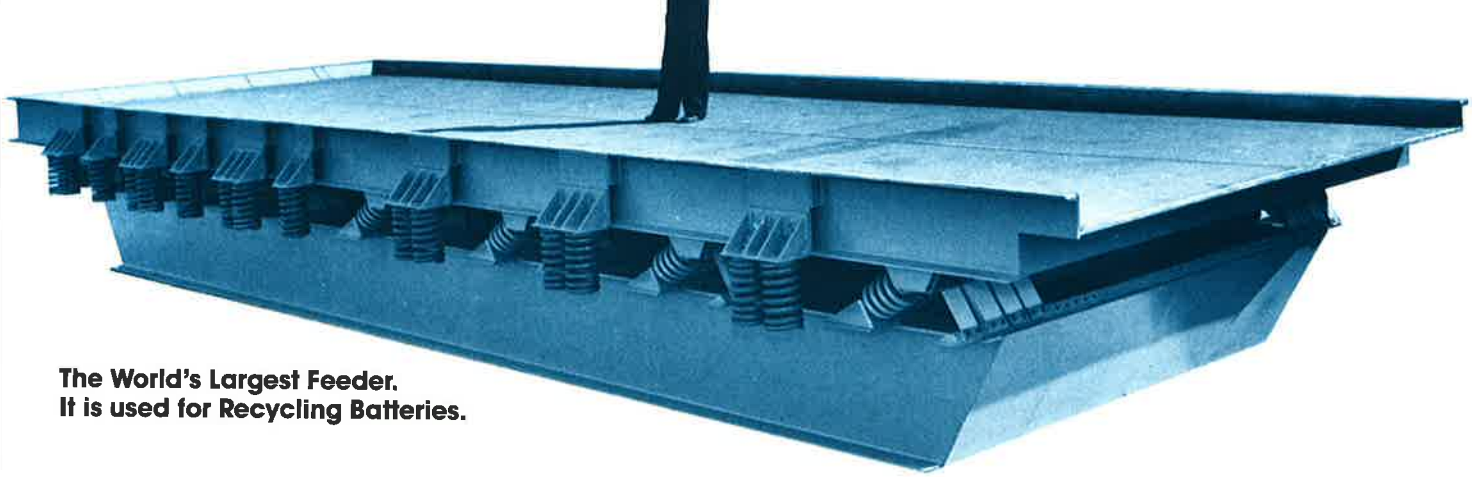


**Fig. 72:** Only the counterbalance can be seen of this 5 ft. wide, 36 inches deep, and 36 feet long feeder supplying fuel to three feed points of a combustor. The fuel is "RDF" or "wood waste", or any combination of either.

Protected by Patent Nos. 4,774,893 4,899,669 4,844,289. Other Applications Pending.

## The "Kinergy King"

**This mammoth machine consumes less than 10 HP!**



**The World's Largest Feeder. It is used for Recycling Batteries.**

Opposite dump door

Drain for electrolyte

Looking upstream

Lifting ramp

Batteries now slide

20 tons dropped 14 ft.!

At times, 40 ton loads

Batteries at discharge

**Fig. 73:** To qualify all the theory and the performance level of the Kinergy Drive System, this mammoth feeder probably does it best. For that reason, it is affectionately called the "Kinergy King".

It is 12 ft. wide by 38 ft. long and it requires only 10 HP.

Installed under a large dump hopper, it makes up the "flat floor" that is needed to achieve the most storage space in the least amount of height. Trailer truck loads of 20 tons of discarded electric batteries from vehicles are repeatedly dropped into the feeder. In turn, it feeds them to a shredder so the metal and other wanted elements they contain can be recovered and "recycled".