Automatic Feeding Mechanism for Embossing of Welding Rods

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Abstract- **Embossing is a conventional process used in the stamping and printing industry, where it is used stamp the logo. Conventionally manual feeding of components is provided into machines due to the design complications and limitations, which reduces the output capacity. Automatic wire feeding mechanism for rod diameter 1.6 mm, 2.4 mm & 3.2 mm is designed and manufactured for embossing purpose**.

Keywords—Welding rod, Hopper, feeding mechanism, Key, Shaft, Bearings, Motor Speed reduceing drive, electrical unit.

INTRODUCTION-

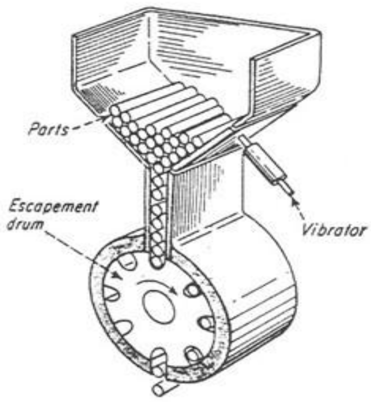
A suitable mechanism has been developed in the following research where multiple already present options were taken into consideration while deciding the final outcome and the cost for the same. The undesired outcomes and the issues following are explained in detail where the suitable mechanism is then finalized according to the industry requirement and budget.
The developed mechanism also favors the functioning and the space constraints of the industry where complex automated machinery is equipped with series of operations lined up.
This project is a successful attempt to fulfill the industry requirements within the space and budget constraints also providing a degree of flexibility to meet their production demands using automation.

SELECTION/DEVELOPMENT OF MECHANISM- MECHANISM NO- 1

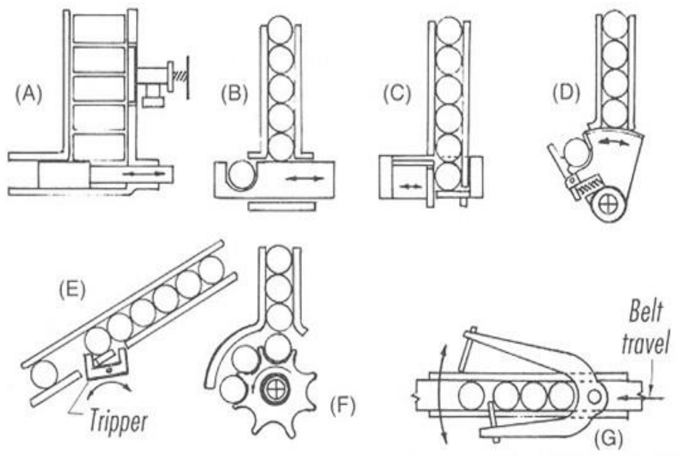
Feeding Mechanisms Feeding long U-shaped parts

When parts arrive in bulk, they often need to be oriented and fed to the next machine. On the left cylinders (rods in this case) in bulk are placed in a hopper. The vibrator serves to arrange the cylinders such that their long axes are parallel and help to prevent clogging. The cylinders then drop down a chute where they are fed into a slot in a wheel. The cylinders exit the machine with uniform orientation as long as their ends are the same. If the ends of the cylinders are different then it will be necessary to run them through an orientation mechanism. This is shown on the next slide on the right u-shaped pieces lie in a randomly oriented pile. The rotary center blades catch the parts and as the center blades are indexed, the parts slide off of the center blades and onto the blade feeder Feeding long cylinders Feeding U-shaped parts. The drum in the rotor is filled with rods as the parts flow through the neck of the hopper activated with a vibrator. This mechanism is not suitable as there is tangling of rods in the hopper neck and costs go high due to the requirement of precision.

REF: Mechanisms and Mechanical Devices Sourcebook, N. Chironis, N. Sclater, McGraw-Hill Inc., New York, 1996



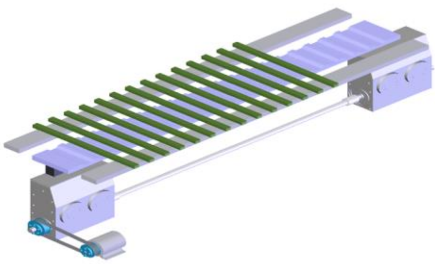
MECHANISM NO- 2



Feeding a certain number of parts

It is sometimes necessary to feed a certain number of parts to the next machine. The examples shown on the left feed one and three parts at a time, respectively at other times it is necessary to mix different parts together. The figure on the right combines donut-shaped parts with solid parts Feeding a certain number of parts Mixer
This mechanism is not suitable due to complex mechanisms and maintenance time and costs.

REF: Mechanisms and Mechanical Devices Sourcebook, N. Chironis, N. Sclater, McGraw-Hill Inc., New York, 1996

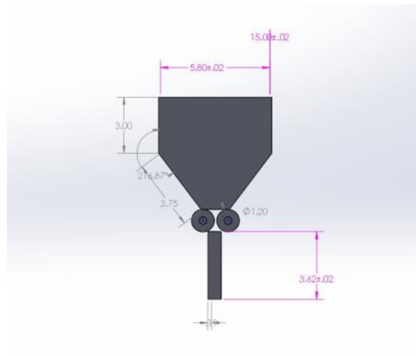


MECHANISM NO- 3

Feeding Mechanism for Bar Stock

Mechanically synchronized Parts Handlers are used to actuate a preformed transfer plate designed to hold the work pieces for even-pitch feeding. The drive is mechanically synchronized to deliver high accuracy at high speeds. This mechanism is rejected due to space and budget restrictions.

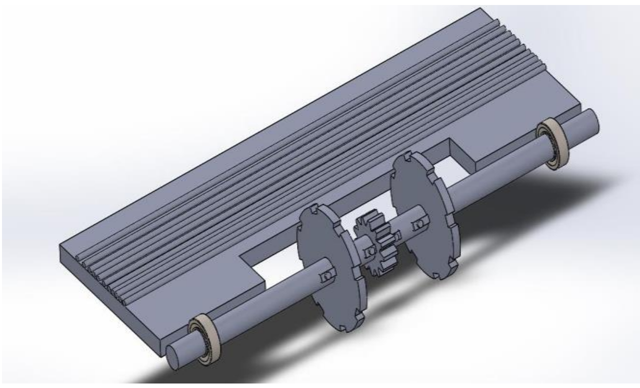
MECHANISM NO- 4



Reasons for rejection are as follows-

Choking of rods in the hopper throat is one of the biggest issues faced in this mechanism where the rods also tangling among themselves. The Cost is also relatively high which does not go hand in hand with the industry budget and cost estimation. The rollers need to be of higher strength material as the flow of raw material between and through them should not indent and damage the functioning of the mechanism itself which attracts more production and maintenance costs. The physical structure of the raw material can also be disturbed with more forces acting on it while in operation between rollers. The above mentioned issues also make a complete halt to the production until it is resolved thus making it prone to strict supervision

MECHANISM NO- 5



Reasons for acceptance are as follows-

The developed mechanism has fair cost of production and operation and is low on maintenance. It also fulfills the feed rate requirement of the industry where the mechanism is simple and equipped with a VFD for variable feed rate as per the industry demand. The mechanism is low on space requirement as well which fits the industry constraints. Physical structure of raw material is not disturbed while in operation as the mechanism does not enforce any crushing or shear force on the raw material ensuring their dimensions remain intact. Hence the mechanism NO-5 is selected and proceeded with further design calculations.

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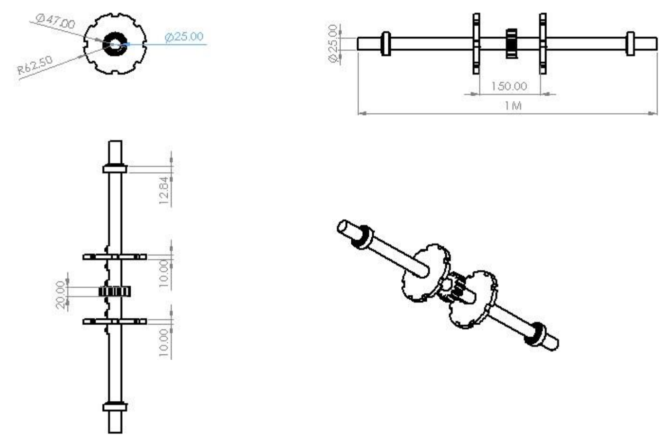
The mechanism is driven with a chain drive for which the design calculations are expressed below. As the rods are fed in the tray, the rods flow over an inclined angle onto the rotating disc which then holds and moves the rods to feed the embossing machine at the set speed. The rotating disc is mounted over a shaft which is held freely in place by two distant bearings.

2-D DRAWING-



Actual Setup-

DESIGN CALCULATIONS-

1. DIAMETER OF SHAFT

P= 0.75 Kw …. (Motor)
ϭyt= 840 Mpa
N= 20 RPM …(Assume)
We know that,
P= 2πNT/60000
Also,
T= 358.098*10^3 Nm
Now,
$T = \pi 16 * \tau * d^3$
Selecting Material- Mild steel
ϭyt= 840 N/mm^2
τ = 0.5*ϭyt/(FOS)
Where FOS= 3
$T = \pi 16 * \tau * d^3$
Solving we get,
d= 23.52mm
thus, d= 25mm

2. DESIGN OF DISC

Angle per slot- 360/8 = 45°
Selecting depth of slot,
If we consider the same or near to same diameter as the rod, chances are that the rod may slip off as there is no other grip to adhere to.
If we consider the diameter double or near to double, chances are that the slot may hold more than one rod which is not acceptable.
Hence considering and assuming 1.5 times the diameter of rod as optimum depth.
Depth = 1.5 times diameter
Weight of disc = 1.3 Kg (Approx.)
Inclination angle of tray = 15-20°… (To take advantage of gravitational force)

3. DESIGN OF CHAIN

P= 0.75 KW, N= 20 RPM
Design power-
[p] = P*Ks
Where,
Ks= K1*K2*K3*K4*K5*K6
[p] = 0.75*1.875
[p] = 1.406 KW
Now, Selection of Z1 And Z2,
I= 1.3 …[PSG]
Z1= 13
Z2= i*Z1
Z2= 1.3*13= 16.9 Ie = 17
Selection of roller chain,
Std. chain – 0-8-A-1
Pitch= 12.7 mm
d1= pitch/(Sin180/13) = 12.7/(180/13)
d1= 53.06mm
V= πd1N1/60= 0.055 m/s
Ft = [p]/ V = 25.56 N
Bearing Area = 44 Cm^2
Induced stress= Ft/A = 0.58 N/m^2
Permissible stress,
ϭbr = 102Ks*[p]/(A*V)
ϭbr = 102*1.875*1.406/(44*0.055)
ϭbr = 111.11 N/m^2
Rematching,
ϭbr permissible > ϭbr induced
Hence,
Pitch = 12.7 mm, d = 7.95 mm
Width between plates = 8 mm
Weight per meter = 0.69 KgF/m

4. CALCULATION OF SPROCKET DIA

d1 = 53.06 mm
d2 = pitch/ Sin (180/17) = 69.11 mm = 70 mm
Initial Centre to centre distance-
a0 = 30 to 50 p
Assume a0 = 40p = 40*12.7 = 508 mm
Approx. No of Links,
lp = 2ap+((Z1+Z2)/2)+(((Z2-Z1)/2π)^2)/ap
ap = a0/p = 40
hence on calculating,
lp = 95 mm
Length of chain = lp*Pitch = 95*12.7 = 12.6.62 mm
Now, recalculating correct centre to centre distance,
[a] = e+ √((e^2-8m)/4) * Pitch

Where,
e = lp-((Z1+Z2)/2) = 95- ((13+17)/2) = 80
and, m = ((17-13)/2π) ^2 = 0.405
Thus on Calculating we get,
[a] = 333.93 mm

THE DESIGN IS SAFE.

RESULTS & DISCUSSION-

Frequency (VFD) (Hz)	Actual results	Rods/ min
5	No empty slots	7
7	No empty slots	12
11	No empty slots	18
15	No Empty slots	22
20	Partial Empty slots	23
40	Partial Empty slots	60
41	Empty slots	64
43	Empty slots	67

It is noted that during the running phase there are no empty slots till the VFD frequency reaches 15 Hz and speed reaches 22 rods/min. But, after that as VFD frequency is increased, it is observed that chances of slot being empty also increases, as rods speed is also increased. As Industry requirement is at lower speeds, our results prove to be useful as it avoids empty slots and tangling of rods. Also, in case of flexible industrial requirement we can vary rods speed at lower speed range. Thus, VFD will be operated at frequency range of 05 Hz to 15 Hz

CONCLUSION-

Out of various mechanisms researched, the final mechanism developed is most suitable and optimum for the working and sustainability of the embossing machine within tolerable maintenance costs which suits the needs and the budget of the industry.

The space constraint requirement of the industry is fulfilled as well and ensures that the production line is not disturbed in any way. The raw material is also not disturbed with dimensions nor is it physically damaged while in operation. The industry demanded flexibility is achieved with variable feed rate as per their production demands. Also, as the mechanism is automated, it does not employ or involve manual labour, making it safe for continuous operation and also saving the industry labour costs

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