Aug. 14, 1962 D. C. DAVIS, JR., ETAL 3,048,892

POWDER APPLICATOR

Filed June 12, 1959 2 Sheets-Sheet 1

Fig. 1.

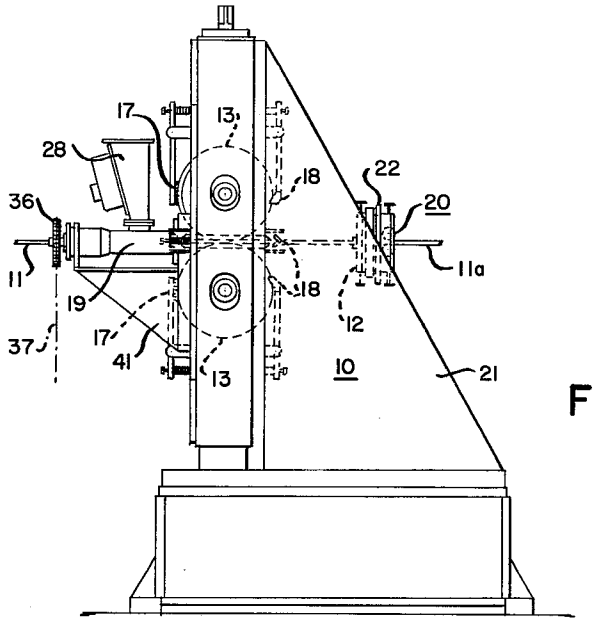


Fig. 9.

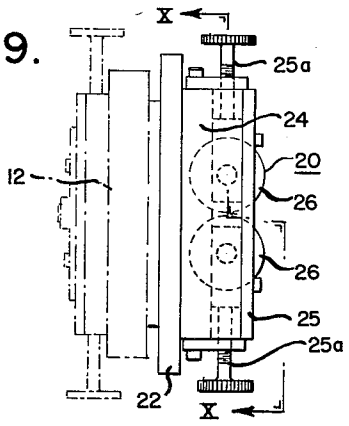


Fig. 10.

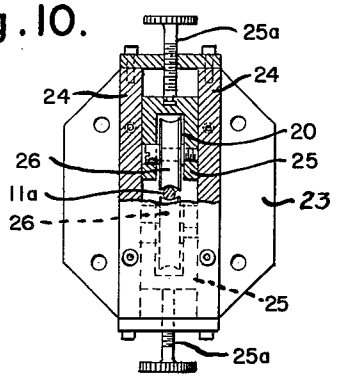


Fig. 5.

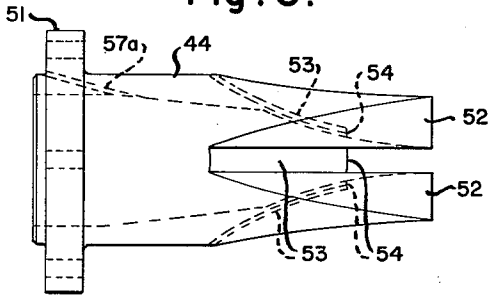


Fig. 8.

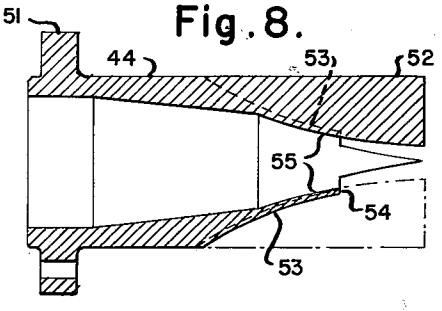


Fig. 6.

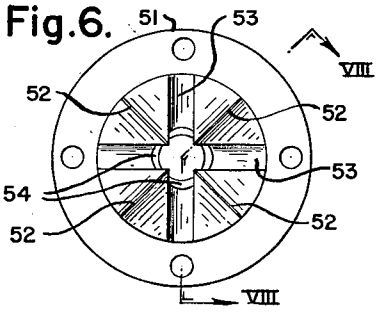
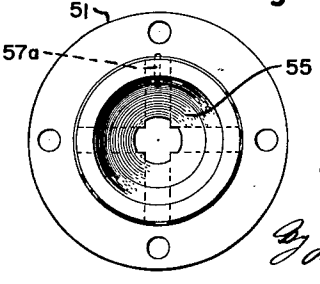


Fig. 7.



INVENTORS
Dexter C. Davis, Jr.,
John F. Freeman &
John G. Kura

By Hoopes Leonard & Buell
their Attorneys

Aug. 14, 1962 D. C. DAVIS, JR., ETAL 3,048,892

POWDER APPLICATOR

Filed June 12, 1959 2 Sheets-Sheet 2

Fig. 2.

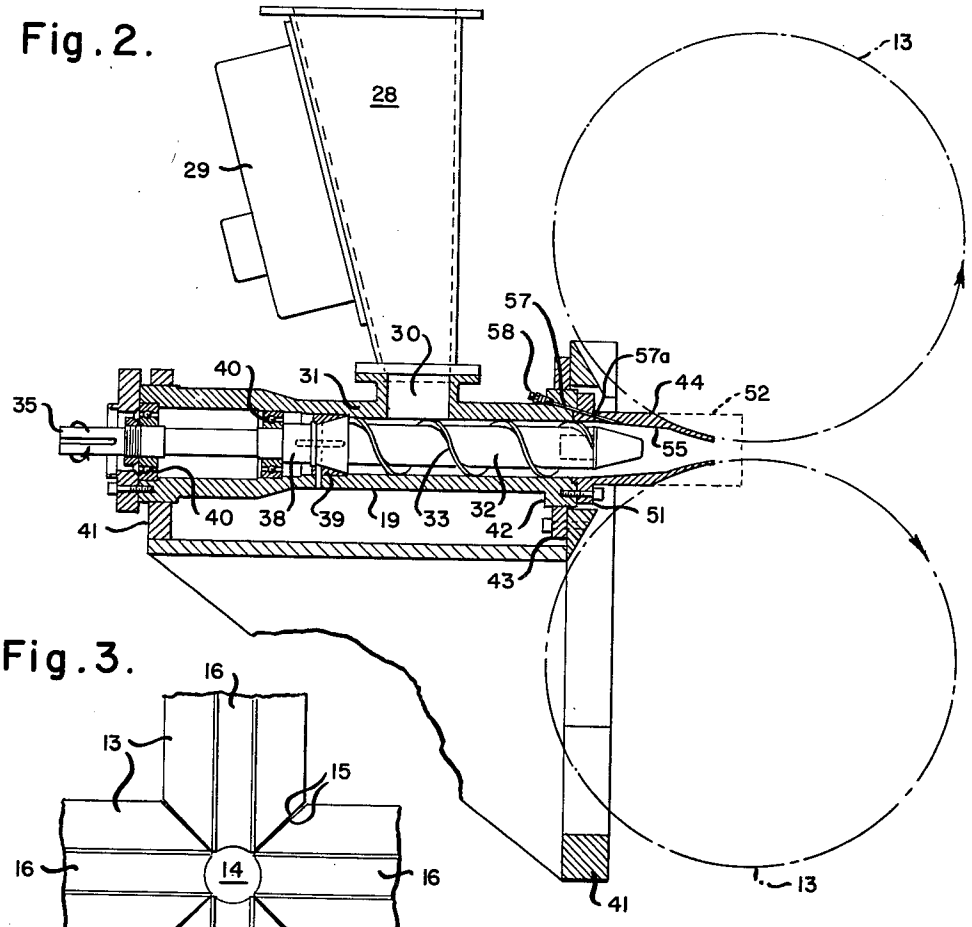
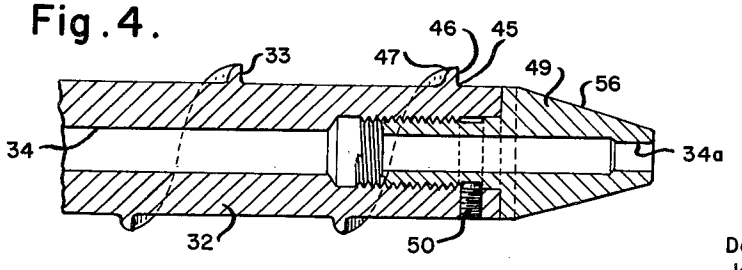


Fig. 3.

Fig. 4.



INVENTORS
Dexter C. Davis, Jr.,
John F. Freeman &
John G. Kura

Hoppe, Leonard & Reed
their attorneys

United States Patent Office 3,048,892 Patented Aug. 14, 1962

3,048,892

POWDER APPLICATOR

Dexter C. Davis, Jr., Muskegon, Mich., John F. Freeman, Sacramento, Calif., and John G. Kura, Columbus, Ohio, assignors, by mesne assignments, to Copperweld Steel Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed June 12, 1959, Ser. No. 820,044
8 Claims. (Cl. 18—13)

This invention relates to a device to feed powder uniformly around an elongated core for roll compaction of said powder in the course of the manufacture of clad rods and wires. More particularly, this invention pertains to a preferably horizontal helical screw and nozzle feeder cooperating with compacting rolls to produce a densified cladding of such powder material concentrically around the surface of such core with substantially continuous guidance of the powder until it is engaged by the compacting rolls.

In the production of clad rods and wires such, e.g., as "Alumoweld" aluminum cladding of ferrous core rod or wire by the system described in United States patent application Serial No. 773,125 filed June 16, 1958, it has been discovered that concentricity and uniformity of application of powder material to a rod or wire core undergoing cladding by such material is promoted, particularly when the core is moving horizontally in a work pass line, by a device of this invention wherein feeding of the powder is made to take place in a positive manner with surrounding guidance substantially without constriction to the zone of engagement by compacting rolls having a closed rolling pass where desired densification and compaction of the cladding material are achieved. As a consequence, continuous production is obtainable in a practical operation without significant interruption due to malfeeding or other troubles arising out of the powder feeding and roll compacting stage thereof.

Other objects, features and advantages of this invention will be apparent from the following description and the accompanying drawings, which are illustrative of one embodiment only, in which

FIGURE 1 is a view in side elevation of a roll compacting mill stand having a powder applicator device of this invention cooperating therewith;

FIGURE 2 is a somewhat enlarged view, partly in section, of the powder applicator shown in FIGURE 1;

FIGURE 3 is a partial view of the delivery side of a set of Turk's-head rolls in the mill stand of FIGURE 1 looking along the pass line to show the closed compacting pass through to such rolls;

FIGURE 4 is a detailed view in section showing a portion of the helical feed screw and tip in said applicator;

FIGURE 5 is a side view of the applicator nozzle shown on the applicator in FIGURE 2;

FIGURE 6 is a view of such nozzle looking at the discharge end thereof;

FIGURE 7 is a view of such nozzle looking at the entry end thereof;

FIGURE 8 is a view in section of such nozzle taken along line VIII—VIII of FIGURE 6;

FIGURE 9 is a view in side elevation showing a shaver device and an adjustable guide device on the aforementioned mill stand along the pass line; and

FIGURE 10 is a view in section of the adjustable guide taken along line X—X of FIGURE 9.

Referring to the drawings, a roll compacting mill stand **10** is shown with a core rod or wire **11** moving along a pass line and issuing from the stand as a definned, compacted green clad rod **11***a*, such definning being performed by a shaver device **12** described in United States patent application Serial No. 818,715, filed June 8, 1959 for

"Shaver." Four Turk's-head rolls **13** are rotatably mounted on stand **10** to form a closed pass **14** when the rolls are screwed down into engagement with each other with mating surfaces **15** defining longitudinally extending radially directed parting planes intermediate the planes of the respective arcuate grooves **16** around the periphery of each such roll. In the illustrated embodiment, the vertical pair of rolls **13** is driven by means not illustrated and each of the rolls is provided with a lubricating wiper **17** in advance of the nip of the rolls to apply a substantially non-liquid lubricant to the groove and parting plane surfaces of the respective rolls. In addition, scraper blades **18** are suitably mounted following the nip to engage and scrape the mating surfaces or faces of each roll as more fully described in the aforesaid patent application Serial No. 773,125. Such scraper blades keep the mating faces of the rolls free of powder fragments or accretions that might otherwise tend to accumulate upon them.

As the work comprising core **11** and the compacted clad rod **11***a* moves along the pass line through the closed pass **14**, it is held extremely steady by the pulling tension upon the rod toward the delivery end, and more locally, by the guidance it receives between a powder applicator device **19** of this invention and an adjustable guide **20** cooperating with applicator **19**. Guide **20** is mounted on wing plate abutments **21** by means of a mounting plate **22** to which the shaver **12** is also secured, both the shaver and guide having openings therethrough coaxial with the axis of the pass line. The guide **20** has a base plate **23** secured to mounting plate **22** and vertically extending laterally spaced side walls **24** fastened to the base plate on each side of the vertical center line thereof to act as slideways for upper and lower bearings **25**. Each of the bearings is provided with a T-shaped slot to engage a T-head at the bottom of an adjustment hand screw **25***a*. Grooved guide wheels **26** are mounted in the respective bearings **25** to rollably engage the green-clad rod **11***a*, as shown. A cover plate **27** having an opening in the center thereof for the passage of rod **11***a* completes the assembly and when guide wheels **26** are screwed down at start-up of operations, they will steady the work and help to control its path along the pass line with precision as it moves through the mechanism shown in FIGURE 1.

In powder applicator device **19**, there is a hopper **28** from which cladding material in the form of powder to be compacted around core **11** is furnished. A vibrator **29** may be attached to hopper **28** to assist in the movement of such powder through an opening **30** into a casing **31** coaxial with the pass line and having an arbor **32** therein with a single helical screw flight **33** affixed thereto or integral therewith. Arbor **32** is hollow and provided with a coaxial longitudinally extending opening **34** therethrough through which core **11** passes along the pass line. The end **35** of arbor **32** is fixed to a sprocket **36** which is driven by a chain **37** at a selected speed by a motor or other power means (not shown) in a powder feeding direction as shown by arrow **48**. A thrust collar **38** is mounted on arbor **32** and engages a thrust bearing **39** fixed to casing **31**. In addition, roller thrust bearings **40** are provided to longitudinally fix arbor **32** while permitting it to rotate. The applicator **19** is secured in turn to a fixed bracket **41** rigidly secured to the frame of stand **10**. Likewise, one end **42** of casing **31** is in the form of a flange rigidly held in a transverse direction by a clamping ring **43** bolted to the upper part of bracket **41**.

The discharge end of arbor **32** is provided with a counterbored and tapped opening to receive the threaded shank of a tapered tip **49** having an axial opening therethrough which is a continuation of opening **34**. An Allen screw **50** may be provided to lock tip **49** in place with the head of the Allen screw flush with the surface

of arbor 32. Feeding of the cladding powder by flight 33 occurs when the flight face 46 thereof urges the powder toward tip 49 and a nozzle 44 surrounding the discharge end of the helical feed screw and bridging the distance between it and the nip of the rolls 13. To minimize friction between the feeding mechanism and such powder, the base of face 46 may be provided with a fillet 45 and avoidance of sticking appears to be promoted by relieving the rearward portion 47 of the crest of flight 33 behind the forward edge thereof which sweeps very close to the interior of the case 31 in the course of a feeding operation. Preferably, the surfaces of the casing interior and helical feed screw, tip and nozzle which come in contact with such powder are polished, or chromium plated, or both. As the core 11 leaves the passage 34 in tip 49, it passes through a smaller diameter centering portion 34*a* designed to keep the exiting core precisely coaxial with the exit opening of nozzle 44 and the roll pass 14 to insure concentricity of cladding around such core. Such guide portion 34*a* cooperates with guide 20 in such achievement and any tendency to eccentricity may be counteracted by vertical adjustment of the axis of the clad rod 11*a* by corresponding adjustment of the position of grooved wheels 26.

The nozzle 44 is provided with a flange 51 which is secured in position by being fixed to the face of flange 42. Nozzle 44 is hollow and coaxial with the axis of the metal work or pass line passing through the center of the arbor 32 and pass 14. It is irregularly shaped on the exterior to present a substantially continuous interior guiding surface 55, a surface of revolution, for the powder cladding material substantially to the place where that cladding is engaged by the respective surfaces of the cooperating grooves 16 on the rolls 13 to cause core and cladding to enter and pass through the compacting pass 14. Thus, four feathered ribs 52 angularly spaced 90° apart are made of a sharp prow shape to fit closely into the nip between adjoining beveled parting faces defining the respective parting planes 15 of the rolls, without frictional engagement between the roll and nozzle surfaces. Intermediate the sides of the feathered ribs 52, the nozzle is provided with a longitudinal trough surface wall 53 terminating at 54. The trough surfaces fit very close to the open side of the grooves 16 as illustrated in FIGURE 2 and terminate at 54 where the nozzle material is also very thin so that as the powder cladding in contact with nozzle interior surface 55 leaves the nozzle, it will make an uninterrupted, smooth transition to engagement with grooves 16 for the rolling thereof to compact such powder against the core 11 as the grooves move through their contact arc and the narrowest portion of the pass at the plane through the axes of the respective rolls 13.

Moreover, the surface 55 in nozzle 44 is tapered in correlation with the taper of surface 56 on tip 49 and the volume of powder cladding fed by the arbor 32 and flight 33 at the selected speed so that there is a positive feeding without significant cross sectional constriction of the cladding powder before it is engaged in the groove nip of the rolls 13. In this way, uniformity of cladding around the circumference of the core and along the length thereof is obtainable without gaps, on the one hand, and without detrimental variation in density, or jamming due to interlocking of the powder particles under pressure which occurs with some materials, on the other hand.

An air passage 57 is drilled through flange 42 and continued by a continuation passage 57*a* through nozzle 44 to the interior thereof. A fitting 58 is provided at the head of the passage and used to connect an air hose, for example, to be applied thereto to clean out the nozzle 44 upon the termination of a production run of material or before the inception of a new run, or otherwise, as desired. During a cladding operation, no air is forced through the passage 57.

Various changes may be made in the details of the illustrated embodiment, and other embodiments provided, without departure from the spirit of this invention or the scope of the appended claims.

We claim:

1. In a metal powder material applicator for a metal rod or wire core moving along substantially a horizontal pass line, apparatus comprising, in combination, a plurality of Turk's-head rolls each having a peripheral groove together defining a substantially circular closed pass in the nip of said rolls coaxial with said pass line, a substantially horizontal helical screw feeder for said powder material for cladding having a casing coaxial with said pass line, said casing having a smooth interior surface, a coaxial substantially cylindrical arbor in said casing having a longitudinal passage therethrough for said core, a helical flight on the exterior of said arbor, said flight being substantially cylindrical and having a substantially uniform pitch, a smooth substantially cylindrical tapering tip at the front end of said arbor having a coaxial passage with a narrower diameter guide portion at the discharge end thereof for said core, a nozzle forming the inner end of said casing and having a smooth interior surface tapering in the direction of movement of said pass line, said nozzle extending to said rolls and having feathered rib and trough portions to fit into the nip of said rolls without substantial frictional engagement therewith to provide a substantially continuous passageway from the end of said flight into said closed pass around said core, means for correlating the rotation of said arbor and flight with the movement of said rolls and core, and guide means on the discharge side of said pass for adjusting the axis of a compacted green clad core cooperating with said guide portion to regulate concentricity of said cladding relative to said core.

2. In a metal powder material applicator for a metal rod or wire core moving along a substantially horizontal pass line, apparatus comprising, in combination, a plurality of rolls each having a peripheral groove together defining a closed pass in the nip of said rolls coaxial with said pass line, a substantially horizontal helical screw feeder for said powder material for cladding coaxial with said pass line, said feeder having a casing with a smooth cylindrical interior surface, a substantially cylindrical arbor in said feeder having a longitudinal passage for said core therethrough coaxial with said pass line, a helical flight on the exterior of said arbor, said flight being substantially cylindrical and having a substantially uniform pitch, a smooth substantially cylindrical tapered tip at the front end of said arbor having a passage coaxial with the passage through said arbor and a nozzle forming the inner end of said feeder and having a smooth conical interior surface converging gradually in the direction of movement of said pass line, the space within said nozzle being correlated substantially to avoid compaction of and gaps in said powder material during feeding thereof, said nozzle extending between the end of said flight and the nip of said rolls to provide a substantially continuous passageway of gradually narrowing diameter around said core between said flight and said closed pass.

3. A powder applicator as set forth in claim 2 in which said flight is a single thread flight and provided with a fillet at the base of the feeding face thereof and a slope for relief toward said arbor behind the outermost edge of said feeding face.

4. A powder applicator as set forth in claim 2 in which said flight is mounted on a portion of said arbor having a uniform diameter, said tip is provided with a narrower diameter guide portion in said passage for said core at the discharge end of said tip, and guide means with adjustable grooved guide wheels on the discharge side of said pass to regulate axial coincidence of said core and cladding.

5. In a metal powder material applicator for an elongated metal rod or wire core moving along a pass line, apparatus comprising, in combination, a plurality of rolls having a groove together defining a substantially closed pass in the nip of said rolls normal to and concentric with said pass line, a helical screw feeder for said powder material for cladding coaxial with said pass line, said feeder having a casing with a smooth cylindrical surface, a substantially cylindrical helical screw member in said casing having a longitudinal passage for said core therethrough coaxial with said pass line, said member having a screw flight thereon substantially cylindrical, of uniform pitch and terminating between said pass and a plane normal to said pass line and tangent to the peripheries of said rolls, a nozzle comprising the inner end of said casing extending up to said rolls to form a substantially continuous annular passageway from said flight into said pass, said nozzle having a smooth interior surface around said core tapering in the direction of said pass, means including the space within said nozzle for said material being of gradually narrowing diameter to feed said material continuously against said core while substantially avoiding compaction of and gaps in said material during said feeding, the exterior of said nozzle having a shape to fit close to said rolls and pass and substantially terminating thereat.

6. In a metal powder material applicator for an elongated metal rod or wire core moving along a pass line, apparatus comprising, in combination, a plurality of rolls having a groove defining a substantially closed pass in the nip of said rolls coaxial with said pass line, a helical screw feeder for said powder material for cladding coaxial with said pass line, said feeder having a casing with a smooth cylindrical interior surface, a helical screw member in said feeder having a longitudinal passage for said core therethrough coaxial with said pass line, said member having a screw portion therein substantially cylindrical and of uniform pitch, a nozzle comprising the inner end of said casing and extending substantially into engagement with said rolls, said nozzle having a smooth interior tapering in the direction of movement of said core and forming a substantially continuous non-compacting passageway of gradually narrowing diameter around said core between said screw portion and said closed pass, said nozzle having portions to fit up close to said rolls and pass, and guide means on the discharge side of said closed pass for adjusting the axis of a compacted green clad core in cooperation with said passage to regulate the concentricity of said cladding material and said core.

7. In metal powder cladding for an elongated metal rod or wire core comprising, in combination, moving an elongated rod or wire core along a work line toward and through a closed pass defined by rolls, feeding a continuous enveloping generally cylindrical layer of powder cladding metal in the same direction by a substantially cylindrical screw having a relatively uniform pitch concentrically spaced from the surface of said core and substantially without volumetric constriction of said cladding metal, guiding the outside and inside of said layer along smooth sliding tapering surfaces into gradual engagement with the surface of said core in the vicinity of said pass substantially without volumetric constriction of said cladding metal and continuing said guiding of the outside of said layer and said engagement substantially without volumetric constriction of said cladding metal to the place where said layer in engagement with said core is engaged by the nip of said rolls, and rolls engaging the outside of said layer substantially immediately upon termination of said guiding to compact said layer against said core.

8. A method as set forth in claim 7, in which said work line is substantially horizontal, said core is pulled along said work line and said feeding is substantially at ambient temperature.

References Cited in the file of this patent

UNITED STATES PATENTS

888,299	Benjamin	May 19, 1908
1,199,080	Jones	Sept. 26, 1916
2,183,959	Dunsheath	Dec. 19, 1939
2,760,229	Cheney et al.	Aug. 28, 1956
2,790,202	Lorenian	Apr. 30, 1957

FOREIGN PATENTS

215,152	Australia	May 29, 1958

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,048,892 August 14, 1962

Dexter C. Davis, Jr., et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 9, for "substantially a" read -- a substantially --; column 6, line 9, after "core" insert -- the steps --.

Signed and sealed this 18th day of December 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents