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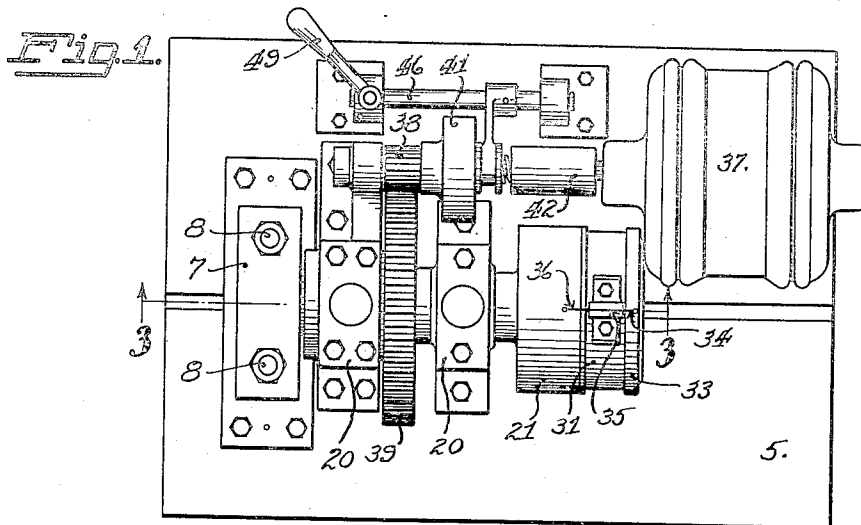
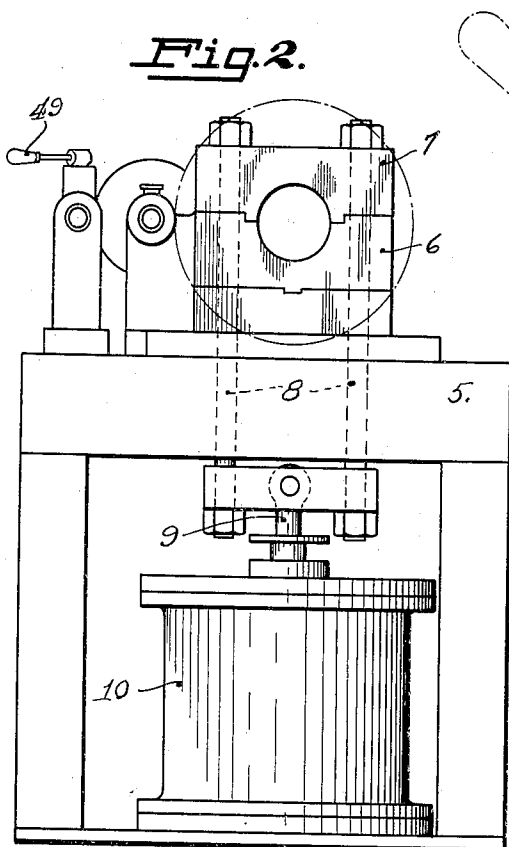
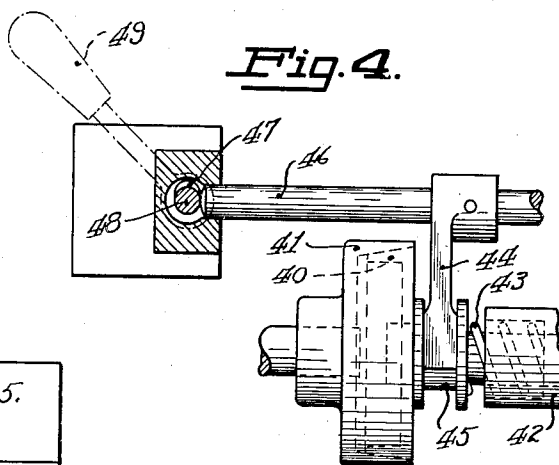
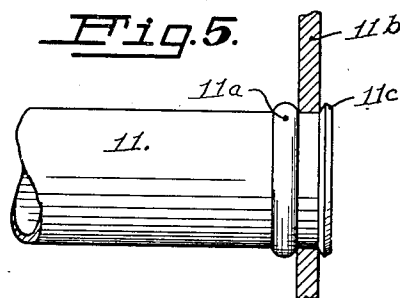
F. W. STRACHAUER ET AL

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FLUE BULGING MACHINE

Filed Nov. 21, 1928

2 Sheets-Sheet 1



INVENTORS
 Frederick W. Strachauer
 Frank B. Gillett
 by Barth & Barth
 ATTORNEYS.

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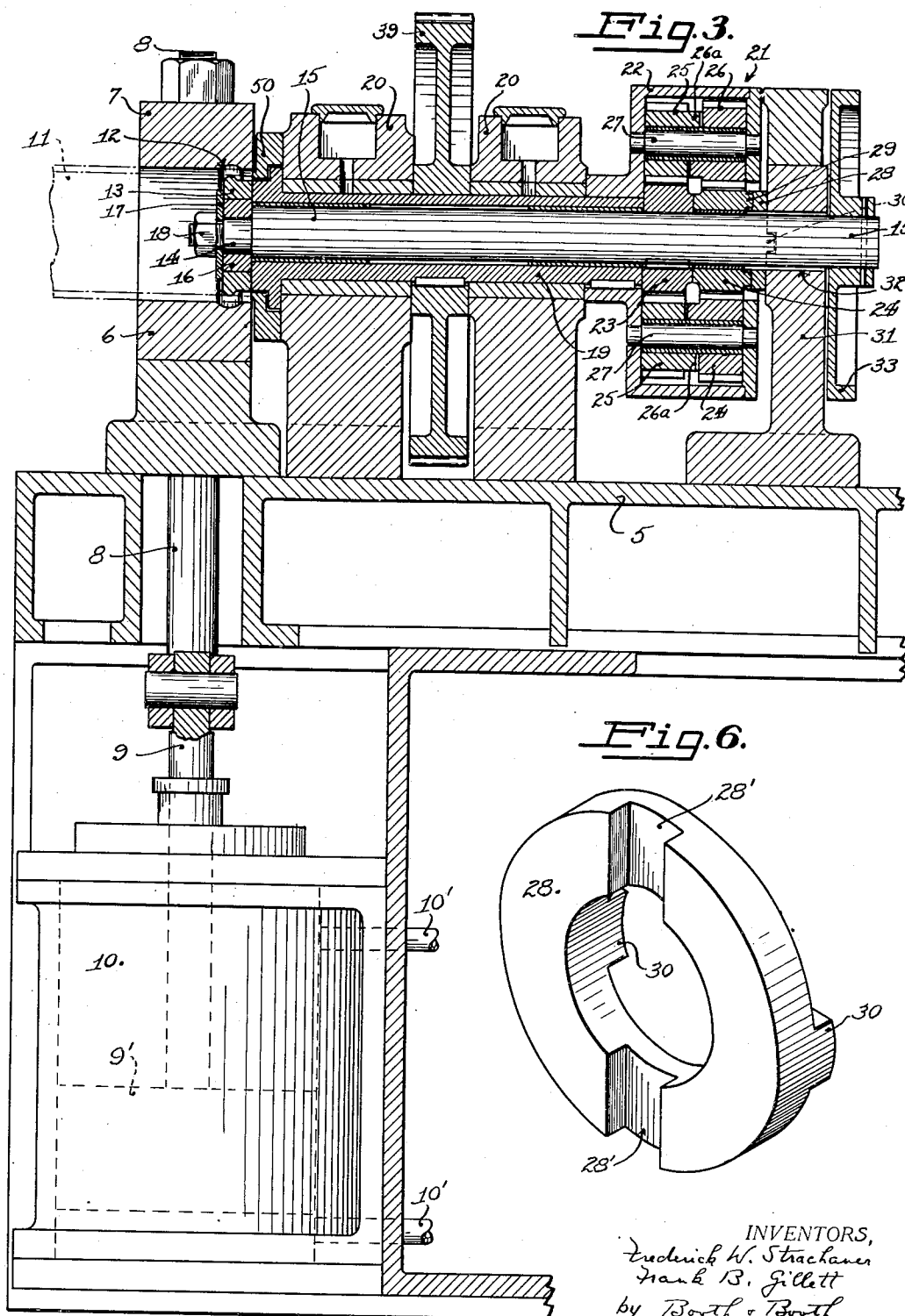
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FLUE BULGING MACHINE

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2 Sheets-Sheet 2



INVENTORS,
 Frederick W. Strachauer
 Frank B. Gillett
 by Booth & Booth
 ATTORNEYS.

UNITED STATES PATENT OFFICE

FREDERICK W. STRACHAUER AND FRANK B. GILLET, OF SACRAMENTO, CALIFORNIA

FLUE-BULGING MACHINE

Application filed November 21, 1928. Serial No. 320,915.

Our invention relates to a machine for producing an annular bulge in the wall of a cylindrical object such as a pipe or tube.

In some boiler tubes, especially superheater flues in locomotive boilers, it is the common practice to form an annular bulge about 1 inch from the end of the flue. This bulge forms a stop or shoulder bearing against the inside of the flue sheet, the extremity of the flue being subsequently swaged over the outside of said sheet.

The principal object of our present invention is to provide a machine for forming the described bulge in superheater flues rapidly and accurately.

It is to be understood that our machine is not limited to the described use, but is capable of producing an annular bulge for any purpose whatsoever in any cylindrical tubular object. It is also to be understood that the form, construction and arrangement of the several parts hereinafter described and herewith illustrated may be varied, within the limits of the claims hereto appended, without departing from the spirit of the invention as expressed in said claims.

A preferred embodiment of our invention will now be described with reference to the accompanying drawings, wherein:—

Fig. 1 is a plan view of the complete machine.

Fig. 2 is an end elevation thereof as viewed from the left of Fig. 1.

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1, and enlarged.

Fig. 4 is an enlarged horizontal detail of the clutch mechanism shown in Fig. 1.

Fig. 5 is an elevation of the bulged tube or flue, showing the manner of its use.

Fig. 6 is a perspective detail, enlarged, of the clutch ring 28 shown in Fig. 3.

In the drawings, the reference numeral 5 designates a stand or base for supporting the machine. At one end of said stand is a chuck or vise for holding the tube to be bulged, said chuck comprising a lower fixed jaw 6 and an upper movable jaw 7. The latter is secured upon vertical slidable rods 8 which extend through the base 5 and are secured to a piston rod 9 of an air or other fluid pressure

cylinder 10, said cylinder having a piston 9' and suitable fluid connections 10', as indicated in Fig. 3. It will be readily understood that the upper jaw 7 is raised or lowered to release or clamp the tube, shown at 11 in Fig. 3, by the operation of the air cylinder 10. The jaws 6 and 7 are provided with complementary recesses 12, Fig. 3, forming an annular channel into which the metal of the tube is expanded to form the bulge. The bulged tube and the manner of its use is shown in Fig. 5, 11^a being the bulge, 11^b the flue sheet against which the bulge abuts, and 11^c the subsequently swaged end of the tube.

The expanding or bulging of the tube 11 is done by a suitably formed roll 13, Fig. 3, positioned in alignment with the channel 12 of the chuck and rotatably mounted upon a stud 14 projecting eccentrically from the end of a spindle 15. A journal bushing 16 is preferably provided between the stud 14 and the roll 13 and a thrust washer 17 and nut 18 are provided to retain said roll in position.

The spindle 15 is rotatably mounted in a sleeve 19, which is also rotatable in bearings 20 supported by the base 5. The inside and outside bearing surfaces of the sleeve 19 are eccentric. The spindle 15 and the sleeve 19 are connected together by a planetary gear mechanism, designated as a whole by the numeral 21, which causes said spindle to rotate very slowly within the sleeve. In the particular machine illustrated, the spindle 15 rotates once to every 32 revolutions of the sleeve 19, and in the reverse direction, but the exact speed ratio, as well as the direction of rotation of the spindle, is immaterial. The eccentricity of the bulging roll 13 with respect to the spindle 15 and the eccentricity of said spindle with respect to the sleeve 19 are so proportioned that at one point in the relative angular positions of said spindle and sleeve, i. e. once on each 32 revolutions of said sleeve, the roll 13 will be concentric with the interior of the chuck and the tube 11 held thereby. This of course is to enable said tube to be slipped endwise into and out of the chuck and over the roll 13. At all other relative positions of the spindle and the sleeve, the roll is eccentric and therefore projects lat-

erally into the annular grove 12 of the chuck. The motion of the roll 13 starting from its concentric position, is, therefore, in an orbit of gradually increasing radius for 16 revolutions, at which time the maximum expanding effect is produced, after which said orbit gradually decreases in radius for 16 more revolutions, when the roll again becomes concentric. During its period of increasing orbit, of course, the roll expands the metal of the tube 11 outwardly into the annular groove 12 of the chuck, thereby producing the desired bulge.

The planetary gear mechanism 21 comprises a housing 22 keyed upon the sleeve 19, a sun pinion 23 keyed upon the spindle 15, a second sun pinion 24 held from rotating by means to be described later, and pairs of interconnected planet pinions 25 and 26 journaled upon studs 27 carried by the housing 22, meshing with the sun pinions 23 and 24 respectively. The sun pinions 23 and 24 are of slightly different diameter, the former being the larger in the illustration herein shown. It will be seen that as the housing 22 rotates with the spindle 19, it causes the planet pinions 26 to travel around the fixed sun pinion 24 and to rotate upon their own axes as well. This rotation is imparted directly to the smaller planet pinions 25 by means of interengaging jaws indicated at 26^a, and said planet pinions 25, meshing with and traveling about the larger sun pinion 23, cause it and the spindle 15 to revolve slowly.

The whole planetary gear mechanism is concentric with the spindle 15, the sun pinion 23 being fast thereon and the sun pinion 24 journaled thereabout. The housing 22, which is fast upon the sleeve 19, is necessarily eccentric upon said sleeve, and hence has a slight eccentric motion. The sun pinion 24 is held from rotating by a floating collar 28, Figs. 3 and 6, which has a pair of diametrically opposite recesses 28' on one face engaged by lugs 29 projecting from said sun pinion 24, and a pair of diametrically opposite lugs 30 on its other face, positioned 90 degrees from said recesses and engaging notches formed in a pedestal 31 rising from the base 5. This allows said sun pinion 24 to have an orbital motion without rotating.

The spindle 15 is extended freely through the pedestal 31, which has an enlarged bore 32 to permit the eccentric movement of said spindle. A disk 33 is secured upon the end of the spindle, and has, at one point in its periphery, an indicating mark 34, Fig. 1. When said mark is aligned with similar marks 35 and 36 on the pedestal 31 and gear housing 22 respectively, the roll 13 is concentric with the chuck. These marks facilitate stopping the machine at the proper position, i. e. with the roll 13 concentric, to permit insertion and removal of the tube 11.

The spindle 19 is rotated by an electric

motor 37, Fig. 1, and speed reducing gears 38 and 39, the gear 39 being secured upon said spindle. A friction clutch, shown in Figs. 1 and 4, is interposed between the motor and the gear 38, said clutch comprising male and female cone members 40 and 41 respectively, the former being slidable upon the shaft 42 of said motor. A spring 43 holds the clutch in engagement, and it is disengaged by a shifter arm 44 operating in a grooved thrust collar 45 secured to the male member 40. The arm 44 is carried upon a sliding rod 46, which is moved endwise by a cam 47 on the lower end of a vertical rod 48, said rod being rocked by a lever 49.

In operating the machine, the sleeve 19 is rotated until the indicating marks 34, 35, and 36 are aligned, and then stopped. The chuck is opened by means of the fluid pressure cylinder 10, the tube 11, heated to the proper temperature, is inserted until its end abuts against a stop ring 50, Figs. 1 and 3, secured to the left hand bearing post 20; and the chuck is closed, holding said tube firmly in position. The sleeve is then rotated until the indicating marks are again in alignment, during which time the roll 13 revolves in an orbit of gradually increasing radius, thereby expanding the metal of the tube into the groove 12 of the chuck to form the desired bulge, and then returns to its concentric position to permit removal of the tube.

It is to be noted that, because the diameter of the roll 13 is only slightly less than that of the inside of the tube 11, the area of contact between said roll and the tube is very large. This enables the roll to expand the tube quickly without running at unduly high speed, and prevents excessive wear on the surface of said roll. The size of the roll also permits it to have ample bearing surface upon its spindle, thereby minimizing wear at this point.

We claim:—

1. A machine for expanding tubular objects comprising a chuck having a plurality of jaws adapted to surround and hold a tube, said chuck having an annular interior recess; means for separating said jaws; a member positioned within the tube for expanding it into said recess; and means for moving said member in an orbit of gradually changing radius.

2. A machine for expanding tubular objects comprising a chuck having a plurality of jaws adapted to surround and hold a tube, said chuck having an annular interior recess; fluid pressure operated means for separating and holding together said jaws; a member positioned within the tube for expanding it into said recess; and means for moving said member in an orbit of gradually changing radius.

3. A machine for expanding tubular objects comprising an exteriorly journaled sleeve having an eccentric bore; a spindle rotatable within said bore; a member mounted

eccentrically upon said spindle and adapted for contact with the interior of the tube to be expanded; and means for rotating said sleeve and said spindle simultaneously at respectively different speeds.

5 4. A machine for expanding tubular objects comprising an exteriorly journaled sleeve having an eccentric bore; a spindle rotatable within said bore; a member mounted
10 eccentrically upon said spindle and adapted for contact with the interior of the tube to be expanded; and a planetary gear mechanism interconnecting said sleeve and said spindle for rotation at respectively different speeds.

15 5. A machine for expanding tubular objects comprising an exteriorly journaled sleeve having an eccentric bore; a spindle rotatable within said bore; a member mounted
20 eccentrically upon said spindle and adapted for contact with the interior of the tube to be expanded; means for rotating said sleeve; and means connecting said spindle with said sleeve for causing said spindle to rotate at a speed different from that of said sleeve.

25 6. A machine for expanding tubular objects comprising an exteriorly journaled sleeve having an eccentric bore; a spindle rotatable within said bore; a member mounted
30 eccentrically upon said spindle and adapted for contact with the interior of the tube to be expanded; a motor for rotating said sleeve; a clutch interposed between said motor and said sleeve; and means connecting said spindle with said sleeve for causing said spindle
35 to rotate at a speed different from that of said sleeve.

7. A machine for expanding tubular objects comprising a member adapted for contact with the interior surface of the tube to
40 be expanded; means for moving said member in an orbit of gradually changing radius; and means for indicating a point in the movement of said member when the radius of its orbit reaches a predetermined value.

45 8. A machine for expanding tubular objects comprising a member adapted for contact with the interior surface of the tube to be expanded; means for moving said member in an orbit of gradually changing radius;
50 means for indicating the position of said member in its orbit; and means for indicating the point at which the radius of said orbit reaches a predetermined value.

9. A machine for expanding tubular objects comprising a rotatable sleeve; a rotatable spindle eccentrically mounted therein; a
55 member mounted eccentrically upon said spindle and adapted for contact with the interior surface of the tube to be expanded;
60 and mechanism for simultaneously rotating said sleeve and said spindle at respectively different speeds.

10. A machine for expanding tubular objects comprising means for holding a tube; a
35 rotatable carrier member mounted coaxially

with said tube; a second carrier member carried eccentrically and rotatably by the first carrier member; an expanding member eccentrically carried by the second carrier member and adapted for contact with the interior surface of the tube; and mechanism for rotating said carrier members simultaneously and at respectively different speeds.

In testimony whereof we have signed our names to this specification.

FREDERICK W. STRACHAUER.
FRANK B. GILLET.

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