Feb. 25, 1936. R. B. GAGE 2,032,205

METHOD OF AND APPARATUS FOR FINISHING CONCRETE PAVEMENTS

Filed June 9, 1931 4 Sheets-Sheet 1

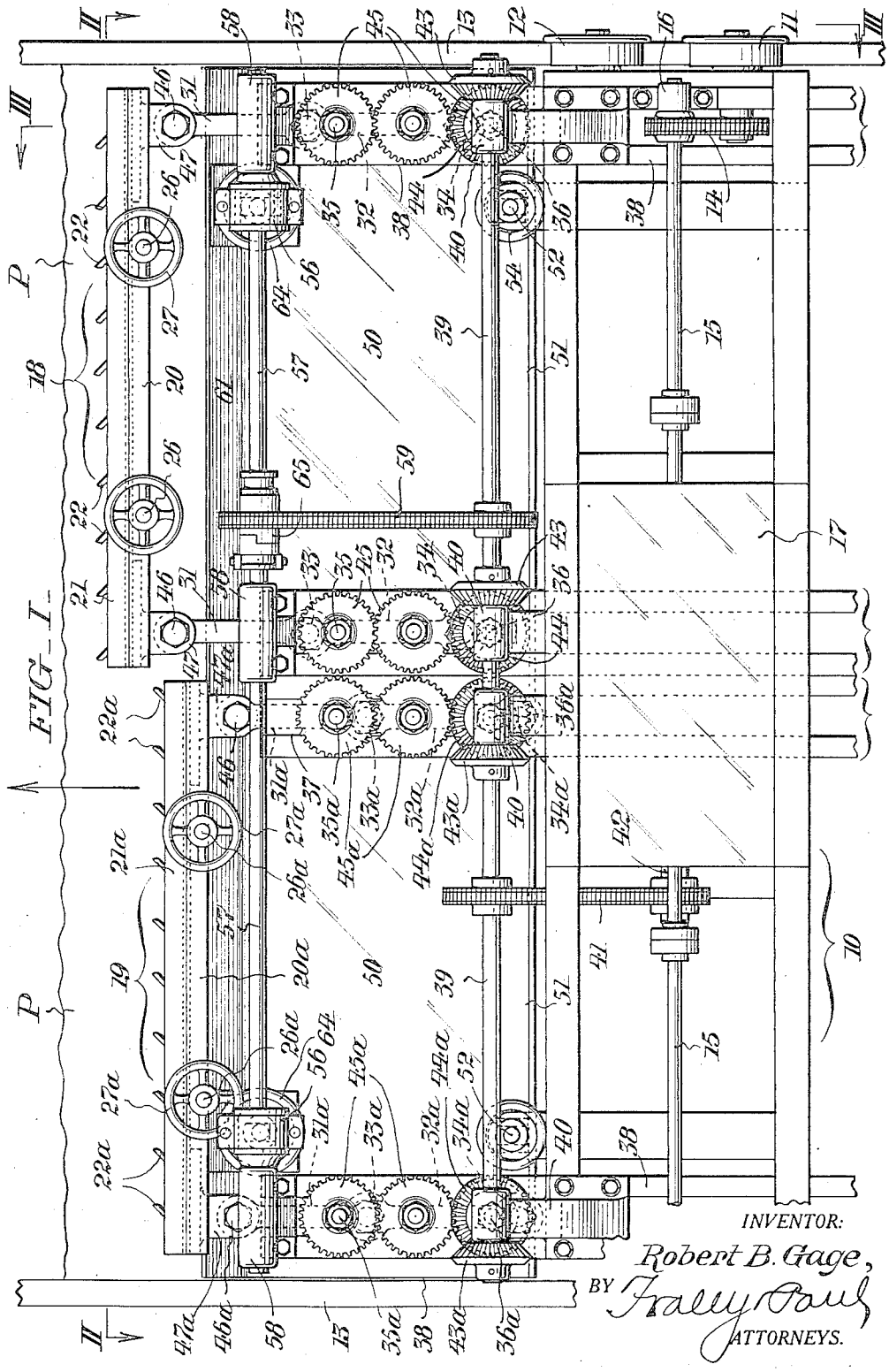


FIG. I.

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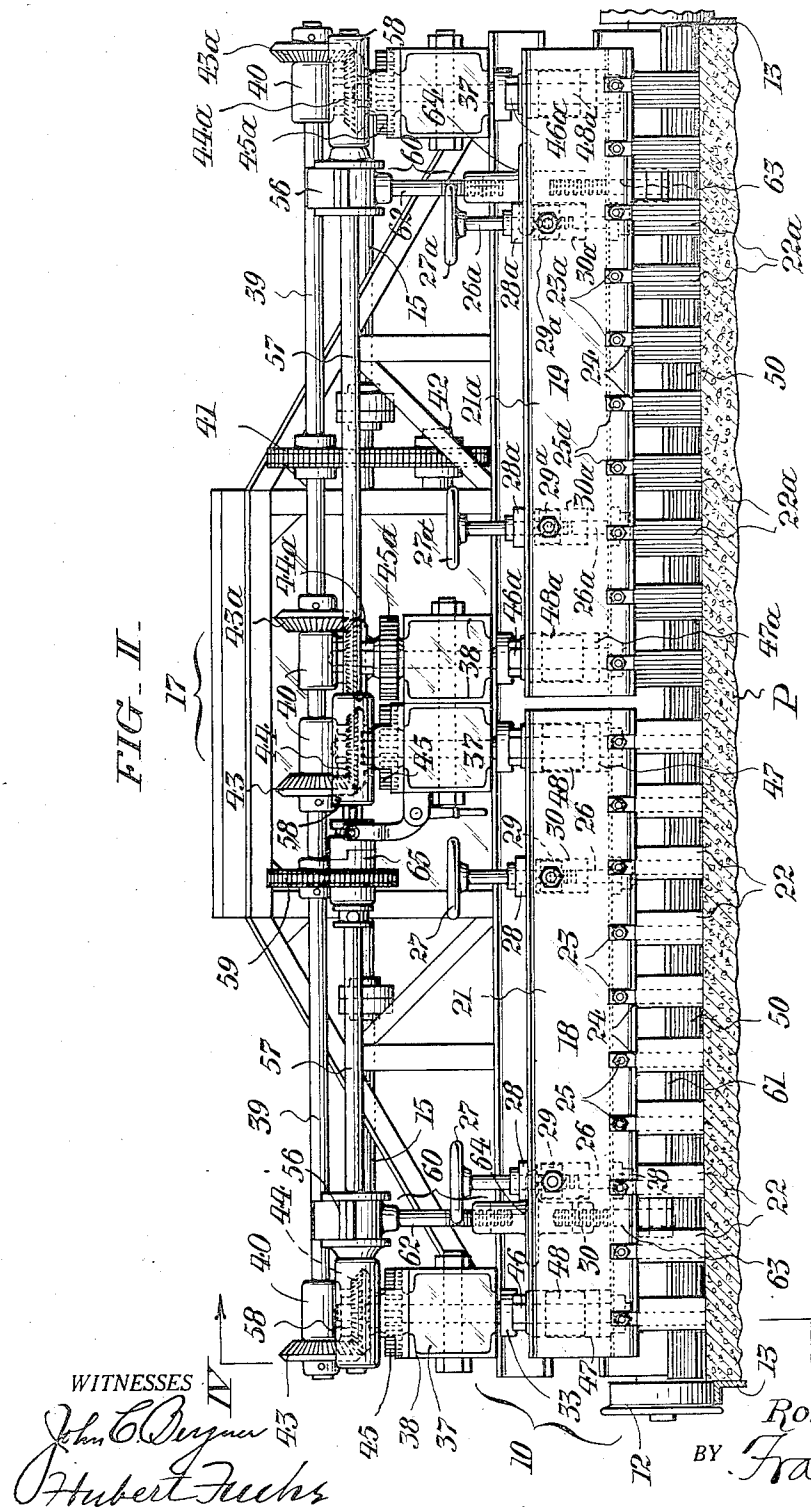


FIG. II.

WITNESSES

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METHOD OF AND APPARATUS FOR FINISHING CONCRETE PAVEMENTS

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FIG. III.

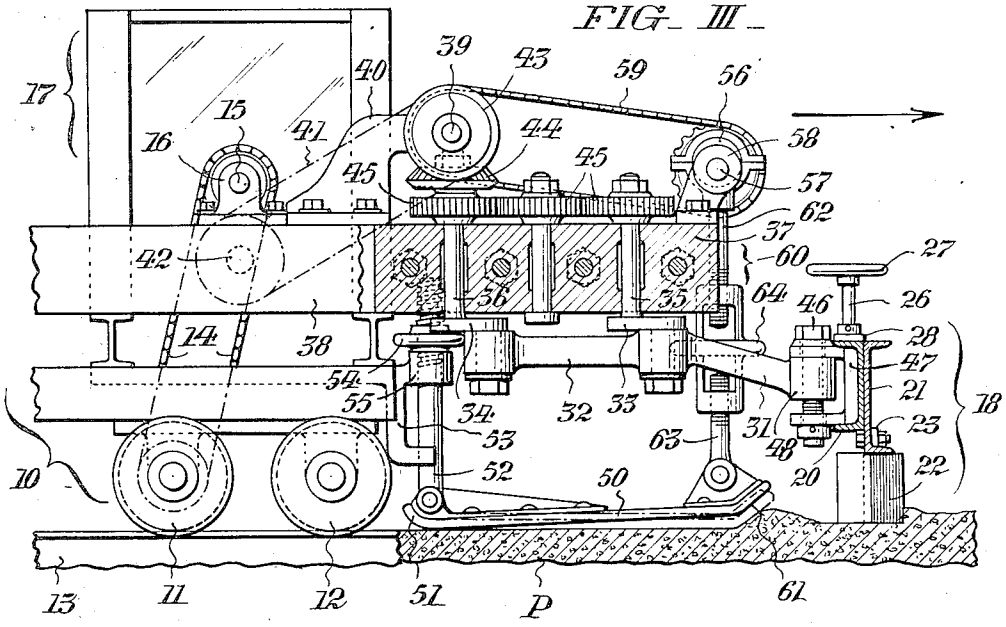


FIG. IV.

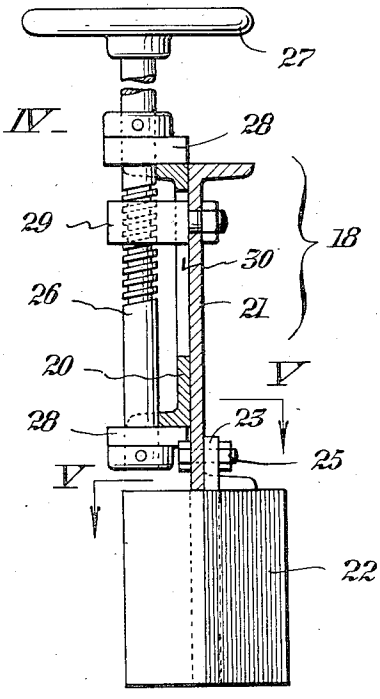
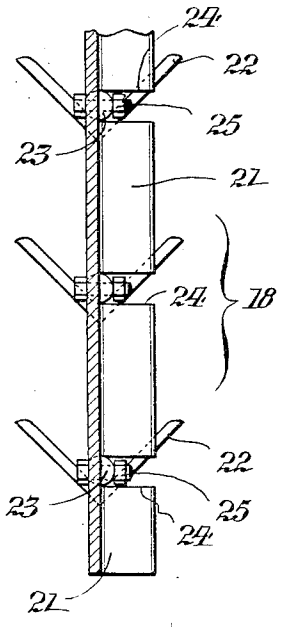


FIG. V.



WITNESSES

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METHOD OF AND APPARATUS FOR FINISHING CONCRETE PAVEMENTS

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FIG. VI

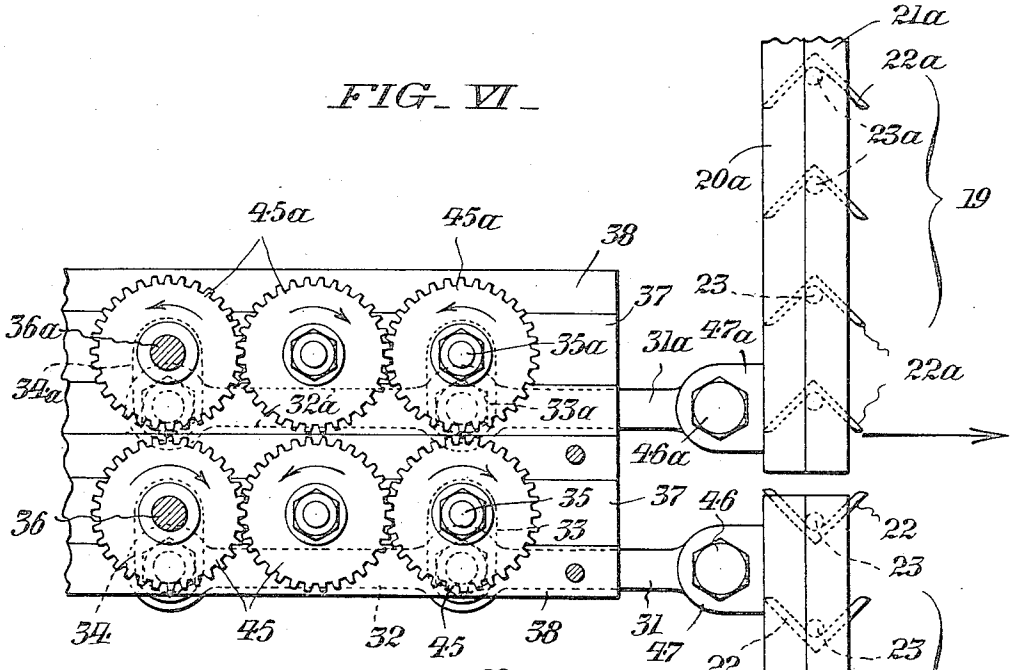
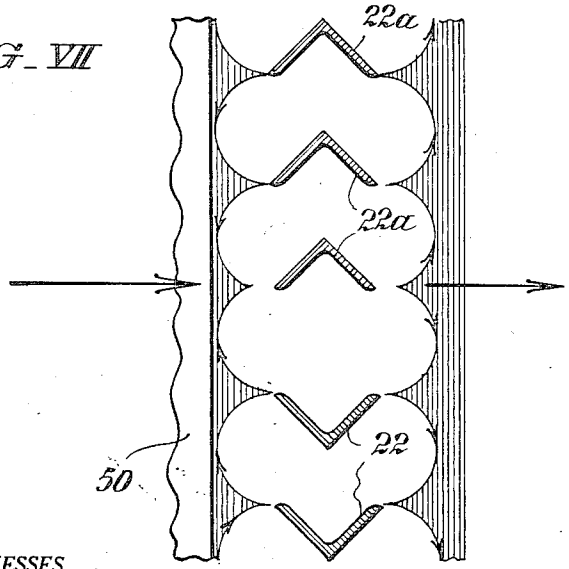


FIG. VII



WITNESSES

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Patented Feb. 25, 1936

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UNITED STATES PATENT OFFICE

2,032,205

METHOD OF AND APPARATUS FOR FINISHING CONCRETE PAVEMENTS

Robert B. Gage, Trenton, N. J.

Application June 9, 1931, Serial No. 543,060

31 Claims. (Cl. 94—33)

This invention relates to methods of finishing concrete pavements, and also to apparatus useful in carrying out such operations.

Ordinarily, incident to concrete road construction, the pavements are finished with the aid of a transverse vertical screed or screeds which are advanced along the surface of the concrete by a carriage running on the forms whereby the side edges of the pavement are defined. With advance of the carriage, the screed removes the excess concrete from the surface of the paving by a scraping action, and under these conditions, the excess accumulates in continuously increasing quantities in front of the screed. Considerable power is thus required to push the increasing accumulation forward, and for this reason apparatus of great strength and weight must ordinarily be used to insure proper traction of the carriage wheels on the side forms. Under the great weight of the apparatus, it often happens that the side forms are depressed below the desired pavement surface grade; and in machines of the type wherein the screed is moved back and forth at right angles to the pavement, the side forms are sometimes spread or forced out of alignment due to the effects of vibration. The latter condition has been known to occur even in instances where two screeds are employed with a view to minimizing and balancing the sidewise vibration, with resultant formation of depressions in the surface of the finished pavement. A further disadvantage of the usual types of screed is that their action results in segregation of the aggregate in the concrete. In other words, the coarse aggregate of the mix is separated from the mortar and carried forward by the apparatus to the transverse expansion joints of the pavement and pushed either onto the subgrade of the roadway, or onto concrete which is below grade. As a consequence of the deficiency of mortar in the material so advanced, porous areas are formed adjacent the joints of the pavement, such areas being invariably the first to disintegrate with subsequent vehicular travel over the roadway. When the finishing operation is suspended for a few minutes, the weight of the excess material which has accumulated before the screed renders the immediately underlying concrete more dense than other portions of the pavement. These consolidated areas will obviously not slump as much as the other portions of the pavement, with consequent formation of bumps in the latter.

My invention has for its chief aims to overcome the various drawbacks above pointed out, and to make possible the construction of concrete pavements which are more uniform in body and less susceptible to scaling and cracking than pavements finished under prevalent methods. This I attain as hereinafter fully disclosed, by progressively and uniformly displacing the excess concrete at the surface of the pavement outward in opposite directions from the center of the latter toward its side edges, without causing segregation of the coarse aggregate; and by progressively squeegeeing the surface levelled as aforesaid to expel entrained air, excess water and mortar from the concrete, with a view toward insuring compactness and homogeneity of the mass, and uniform surface smoothness of the pavement.

Another object of my invention is to make possible the fulfilment of the foregoing, through provisions of an efficient and reliable road finishing apparatus which is comparatively light in weight and therefore conservative as regards power consumption to effect its progression and unliable to cause depression of the side forms; and which moreover, is free from vibration such as would be likely to cause spreading or disalignment of the side forms between which the pavement is confined.

Still other objects and attendant advantages of this invention will be manifest from the detailed description following in coordination with the attached drawings, wherein Fig. I shows a fragmentary plan view of an apparatus convenient to the practice of my novel method of finishing concrete pavements.

Fig. II is a front elevation of the apparatus, as viewed in the direction of the arrows II—II in Fig. I.

Fig. III is a fragmentary illustration, partly in side elevation and partly in section, taken as indicated by the arrows III—III in Fig. I.

Fig. IV is a detail sectional view on a somewhat larger scale taken as indicated by the arrows IV—IV in Fig. II and showing the means for regulating the height of the scraping devices provided for progressively displacing the excess concrete from the surface of the paving.

Fig. V is a fragmentary detail plan section taken as indicated by the arrows V—V in Fig. IV.

Fig. VI is a plan view of the excess concrete removing mechanism; and

Fig. VII is a diagrammatic illustration showing the action of the excess concrete removing mechanism.

As herein shown, the novel apparatus which I have devised to carry out my improved concrete pavement finishing method comprises a carriage 10 of which only the forward end is shown in Figs.

I–III. This carriage is adapted to overtravel the concrete pavement P in the direction indicated by the arrows in Figs. I and III, with its wheels 11 and 12 running on the usual metallic side forms 13 whereby the width of the said pavement is defined. The carriage 10 is slowly progressed through rotation of its wheels 11 by a sprocket chain connection 14 from a transverse power shaft 15, the latter being journalled in fixed bearings 16 and driven by a suitable prime mover, such as an electric motor or a gasoline engine (not shown), enclosed in a housing 17 centrally of the forward end of the carriage.

To remove the excess concrete from the pavement P incident to propulsion of the carriage 10 in the manner just described, I have provided a pair of scraping elements 18, 19 which are disposed transversely of the front of the carriage and which jointly comprehend the width of the pavement P, see Figs. I and II. Except for slight differences hereinafter noted, these scraping elements 18, 19 are identical in construction. I will therefore specifically describe the parts of one of them only, but designate the corresponding parts of the other by like reference numbers, with addition, in each instance, of the letter *a* for the purpose of distinction. As shown, the device 18 consists of a pair of horizontally arranged channel bars 20, 21 placed back to back, the first of the two serving as a support for the other from which latter depend a series of scraping instrumentalities 22. From Figs. I, IV, VI and VII it will be observed that the instrumentalities 22 have the form of divergent faced angular (cutting) blades with upward shanks 23 which are engaged in allocating slots 24 in the bottom flange of the channel bar 21, and which are rigidly secured to the web of said bar by bolts 25. It is to be particularly noted from Figs. I and VI that the angular cutting blades 22, 22*a* of the two devices 18 and 19 are oppositely directed with respect to the longitudinal center line of the apparatus. For the purpose of regulating the depth of the scraping, the channel bar 21 of the element 18 carrying the cutting blades 22 is regulatable up and down through rotation of a pair of screws 26 whereof one is shown in detail in Fig. IV. Each such screw 26 is fitted with a hand wheel 27 at its top, and journalled for rotation in bearings 28 attached to the channel bar 20; while its thread engages a lug 29 that projects rearward from the channel bar 21 through a vertical slot 30 in the channel bar 20. Each scraping device 18, 19 is supported adjacent its opposite ends by forwardly reaching extremities 31 of links 32 which respectively connect a pair of cranks 33, 34 at the ends of vertical shafts 35, 36. Each pair of the shafts 35, 36 is journalled in a bearing block 37 secured between the forwardly projecting ends of the side components of built up longitudinal beams 38 suitably made fast to the top of the carriage 10. Both scraping devices 18, 19 derive motion from a transmission shaft 39 which is supported transversely of the carriage 10 in bearings 40 bolted to the tops of the beams 38, and connected through a sprocket chain connection 41, with a shaft 42 within the casing 17. This shaft 42 is in turn driven, through suitable speed reduction gearing (not shown) also within the casing, from the power shaft 15 previously mentioned. As shown in Figs. I and II, the transmission shaft 39 is fitted with bevel gears 43 and 43*a* which mesh respectively with companion bevel gears 44 and 44*a* on the vertical crank shafts 36 and 36*a*. By means of trains of spur gears 45, 45*a* the crank shafts 35, 35*a* are driven in unison with, and in the same direction as the crank shafts 36, 36*a*.

In order to permit vertical angular adjustment, the channel bars 20, 20*a* respectively of the scraping devices 18, 19 are not rigidly connected to the arms 31, 31*a* of the crank links 32, 32*a*, but with interposition of regulating screws 46, 46*a*. As shown in Fig. III, these screws 46, 46*a* are rotatable in bearing brackets 47, 47*a* on the channel bars 20, 20*a* and take into bosses 48, 48*a* on the arms 31, 31*a* of the crank links 32, 32*a*.

The mechanism which I have provided for concurrently and progressively compacting and smoothing the pavement has the form of a transversely-extending horizontal plate-like screed 50, which, as shown in Figs. I and II, corresponds in width to that of the pavement P between the side forms 13 and lies immediately behind the scraping devices 18, 19. Adjacent or substantially at its rear edge, which is rounded as at 51 in Fig. III and adapted to continuously contact with the pavement surface, the screed 50 is pivotally supported or fulcrumed for up and down rocking movement, by a pair of rods 52. These rods 52 have axial sliding guidance in brackets 53 at the front of the carriage 10; and, as shown, their threaded upper ends are engaged by hand wheels 54 that rest on the tops of the guide bosses 55 of the brackets. The screed 50 is actuated by a pair of eccentrics 56 which are mounted on a cross shaft 57 with journal support in bearings 58 bolted to the tops of the compound channel beams 38 of the carriage 10, the said shaft being driven, through a sprocket chain connection 59, from the transmission shaft 39 which serves the scraping devices 18, 19. As shown in Fig. III, the rods 60 of the eccentrics 56 are pivotally connected to the screed 50 adjacent its forward edge, which latter is turned up somewhat as at 61 so as not to cut into the pavement P. The rods 60 it will be observed from Fig. III, are divided, that is to say, formed in two parts 62, 63; and the said parts are oppositely threaded and coupled by a hand wheel turn buckle 64. The fore and aft edges of the screed 50 are thus independently adjustable vertically in respect to the pavement P. By means of a manually operable clutch conventionally indicated at 65 in Fig. I, the shaft 57 can be uncoupled from the sprocket chain connection 59, and the screed 50 thereby rendered idle if desired or required.

The operation of the apparatus is as follows: Due to the reversed positions of the bevel gears 43, 43*a* on the transmission shaft 39, it is evident that the crank shafts 35, 36 and 35*a*, 36*a* will be respectively rotated in opposite directions with resultant impartation of oscillatory movement to the scraper devices 18, 19 in such manner that the latter will approach and recede from each other in a direction crosswise of the pavement. Thus, as the carriage moves forward, each of the blades 22, 22*a* of the scraping devices will trace a succession of cycloidal curves lengthwise of the pavement. Now, since the angular cutting or scraping blades 22, 22*a* of the two devices 18, 19 are pitched in opposite directions and move contrariwise, it follows that the quantities or batches of the excess concrete displaced by the individual blades from the contiguous small areas on which they act in their gyratory scraping movement are passed from one cutting blade to another, so that the excess is worked and transmitted progressively from the center of the pave-

ment towards opposite sides, step by step from blade to blade, along a continually advancing, narrow transversely-extending zone of the pavement and finally discharged over the side forms to the roadside for convenience of removal. Localized scraping in this way not only precludes segregation of the aggregate in the concrete, but avoids accumulation of excess ahead of the apparatus, such as would be likely to stall the driving motor or to require frequent stoppages of the apparatus. The work which the devices **18** and **19** are called upon to perform is thus relatively light, wherefore it is possible to dispense with considerable weight in the design of the apparatus, and to operate it more economically, from the standpoint of power cost. My invention accordingly assures against depression of the side forms **13** below the desired grade and the formation of undulations, bumps or other irregularities in the pavement. The novel manner in which the scraping devices **18** and **19** are operatively coordinated is also highly advantageous in that a more perfect working balance is maintained between them. Vibration is thereby reduced to a very minimum, and the side forms **13** safeguarded against spreading and disalignment as the apparatus travels along them.

Concurrently with progressive removal of the excess concrete (including mineral aggregate as well as water and cement or laitance) as just explained, the screed **50** following in the wake of the scraping devices **18**, **19** operates to progressively squeegee and thereby compact and smooth the surface of the pavement. In other words, with each downward movement of the screed, a corresponding transverse zone or area of the pavement is compressed and tamped while the rear edge of the screed (which is constantly in contact with the pavement) effects even distribution of the concrete, and defines the general grade of the pavement surface. By the action of the screed, superfluous water and mortar are forced out of the concrete, as a result of which the latter is rendered uniformly compact and homogeneous. The water and mortar and any concrete which may happen to accumulate or be pushed up before the turned up front edge of the screed is passed on to the scraping devices **18**, **19** directly in front of the screed for removal, it being noted from Fig. VII that the blades **22**, **22***a* of the said devices sweep very close to the screed **50**. By means of the handwheels **54**, the height of the screed fulcra can be adjusted relative to the carriage **10**.

In actual practice, I prefer to make several passes over the paving with the apparatus to insure a perfect job, incident to which the hand wheels **27**, **27***a* and **54** are manipulated as required to move the scraping devices **18**, **19** and the screed **50** downward to ultimately determine the grade which it is desired to attain.

Having thus described my invention, I claim:

1. The method of finishing a concrete pavement which comprises removing the excess concrete from the surface and progressively diverting it laterally in opposite directions from the center of the pavement to the side edges thereof.

2. The method of finishing a concrete pavement which comprises scraping the excess concrete off of a continually advancing transverse zone in a multiplicity of small batches, and concurrently transmitting such excess in a succession of concurrent opposite steps to the side edges of the pavement, thus evening the latter without producing large accumulations of excess material thereon.

3. The method of finishing a concrete pavement which comprises gyratorily scraping excess concrete off of a continually advancing multiplicity of contiguous small areas and thereby concurrently transmitting the excess step by step to the side edge of the pavement.

4. The method of finishing a concrete pavement which comprises gyratorily scraping excess concrete off of a continually advancing multiplicity of contiguous small areas, in opposite directions of gyratory action at the opposite sides of the pavement, thereby concurrently transmitting the excess step by step to the opposite side edges of the pavement.

5. The method of finishing a concrete pavement which comprises squeegeeing and thereby compacting and smoothing the surface of the concrete over a continually advancing transverse zone, concurrently scraping excess concrete off of a transverse zone directly in front of the squeegeeing zone in a multiplicity of small batches, and also transmitting such excess step by step along the latter zone to the side edge of the pavement.

6. The method of finishing a concrete pavement which comprises squeegeeing and thereby compacting and smoothing the surface of the concrete over a continually advancing transverse zone, gyratorily scraping excess concrete material pushed up by the squeegeeing off of a continually advancing multiplicity of contiguous small areas directly in front of the squeegeeing zone, and thereby concurrently transmitting the excess step by step to the side edge of the pavement.

7. The method of finishing a concrete pavement which comprises removing the excess concrete from the surface and progressively diverting it laterally in opposite directions from the center of the pavement to the side edges thereof; and immediately thereafter compacting the pavement by progressive surface squeegee action to expel entrained air, excess water and mortar from the concrete for the purpose of increasing its density.

8. The method of finishing a concrete pavement which comprises removing the excess concrete from the surface and progressively diverting it laterally in opposite directions from the center of the pavement to the side edges; and immediately thereafter compacting the pavement by progressive surface squeegee action to expel entrained air, excess water and mortar from the concrete for the purpose of increasing its density, and concurrently smoothing the pavement to uniformly distribute the concrete with attendant elimination of surface voids and determination of a definite grade for the pavement.

9. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and mechanism operative incident to progression of the carriage to remove excess concrete from the surface and to progressively divert it laterally in opposite directions from the center of the pavement toward the edges of the latter.

10. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement, and a multiplicity of blades carried thereby arranged across the width of the pavement, for scraping excess concrete off of the latter in a multiplicity of small batches and concurrently transmitting such excess to the side edge of the pavement.

11. Apparatus in accordance with the preceding claim wherein the blades for the opposite sides of the pavement act toward its opposite side edges.

12. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement, a multiplicity of blades carried thereby arranged across the width of the pavement, and means for giving the blades a gyratory movement as the carriage travels, and thereby scraping excess concrete off of the pavement in a multiplicity of small batches and concurrently transmitting such excess from blade to blade to the side edge of the pavement.

13. Apparatus in accordance with the preceding claim wherein the blades for the opposite sides of the pavement act toward its opposite side edges.

14. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement, a multiplicity of divergent faced blades carried thereby arranged across the width of the pavement, and means for giving the blades a gyratory movement as the carriage travels, and thereby scraping excess concrete off of the pavement in a multiplicity of small batches and concurrently transmitting such excess from blade to blade to the side edge of the pavement.

15. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement, a transverse smoothing member carried by said carriage for acting on the surface of the concrete as the carriage travels, and a multiplicity of blades also carried by said carriage arranged across the width of the pavement directly in front of said smoothing member, for scraping off excess material, including that pushed up in front of said member, and concurrently transmitting such excess to the side edge of the pavement.

16. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement, a transverse smoothing member carried by said carriage for acting on the surface of the concrete as the carriage travels, and a multiplicity of blades also carried by said carriage arranged across the width of the pavement directly in front of said smoothing member, and means for giving the blades a gyratory movement and thereby scraping excess concrete off of the pavement in a multiplicity of small batches and concurrently transmitting such excess from blade to blade to the side edge of the pavement.

17. Apparatus in accordance with the preceding claim wherein the blades are divergent-faced.

18. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and scraping means operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it laterally in opposite directions from the center of the pavement to the edges, the said means comprising a bar with a series of spaced depending blades extending transversely of the carriage, and means for imparting oscillatory movement to the bar to carry out the function aforesaid.

19. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and scraping mechanism operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it laterally in opposite directions from the center of the pavement toward the edges, the said mechanism comprising a pair of transversely arranged bars jointly comprehending the width of the pavement and each provided with a series of depending blades; and means to concurrently oscillate the bars reversely to carry out the function aforesaid.

20. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and means operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it laterally in opposite directions from the center of the pavement to the edges, the said means comprising a bar extending transversely of the carriage and provided with a series of spaced depending angular blades, and means for imparting oscillatory motion to the bar to carry out the function aforementioned.

21. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and scraping mechanism operative incident to progression of the carriage to remove the excess concrete from the surface of the pavement and to progressively divert it laterally in opposite directions from the center of the pavement toward the edges, the said mechanism comprising a pair of transversely arranged bars jointly comprehending the width of the pavement, and provided respectively with oppositely directed spaced depending angular blades in series, and means for concurrently oscillating the bars reversely to carry out the function aforesaid.

22. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and scraping mechanism operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it laterally in opposite directions from the center of the pavement to the edges, the said mechanism comprising a transversely extending bar with a series of spaced depending blades, means for imparting oscillatory movement to the bar to carry out the function aforesaid, and means whereby the bar may be raised or lowered relative to the surface of the pavement to regulate the depth of material removal.

23. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and scraping mechanism operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it laterally in opposite directions from the center of the pavement to the edges, the said mechanism including a transversely extending bar with a series of spaced depending blades, means for imparting oscillatory movement to the bar to carry out the function aforesaid and means whereby the opposite ends of the bar may be independently raised or lowered to change the angle of the bar.

24. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; and mechanism operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it in opposite directions from the center of the pavement to the edges, the said mechanism

including a pair of transversely arranged bars jointly comprehending the width of the pavement and each provided with a series of spaced depending blades, means for concurrently imparting reverse oscillatory movement to the two bars to carry out the function aforesaid; and regulatory means whereby the bars may be independently adjusted angularly in accordance with the crown desired in the pavement.

25. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement, mechanism operative incident to progression of the carriage to remove excess concrete from the surface of the pavement and to progressively divert it laterally to the edge of the pavement; and mechanism for immediately thereafter coincidently tamping and progressively squeegeeing the pavement to expel entrained air, excess water and mortar from the concrete for the purpose of increasing its density.

26. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; mechanism operative incident to progression of the carriage to remove the excess concrete from the surface of the pavement and to progressively divert it laterally to the edge of the pavement; and mechanism for immediately thereafter progressively squeegeeing the pavement to expel entrained air, excess water and mortar from the concrete, thereby increasing its density and concurrently smoothing the pavement to uniformly distribute the concrete, with attendant elimination of surface voids and determination of a definite grade.

27. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; mechanism operative incident to progression of the carriage to remove the excess concrete from the surface of the pavement and progressively divert it to the edge, including a transversely arranged oscillating bar with a series of spaced depending blades; and cooperating mechanism to compact the scraped pavement by progressive squeegee action for the purpose of expelling entrained air, excess water and mortar from the concrete to increase its density, and at the same time uniformly distribute the concrete with attendant elimination of surface voids and determination of a definite grade for the pavement, the latter mechanism including a screed disposed rearward of the said scraping bar aforementioned and having the form of a vertically horizontal plate corresponding in width to the paving between the side forms and pivoted along one of its transverse edges in constant contact with the pavement surface, and means for imparting up and down rocking movement to the screed to carry out the functions aforesaid.

28. A concrete pavement finishing apparatus comprising a carriage adapted to travel on the side forms defining the edges of the pavement; mechanism operative incident to progression of the carriage to compact the pavement by progressive squeegee action for the purpose of expelling air, excess water, and mortar from the concrete to increase its density, and at the same time to uniformly distribute the concrete with attendant elimination of surface voids and determination of a definite grade for the pavement, the said mechanism including a screed in the form of a horizontal plate corresponding in width to the paving between the side forms, the said screed being pivoted along its rear transverse edge for up and down movement into and out of contact with the pavement, and having its forward edge upturned; and means in advance of the screed operative to progressively divert the concrete displaced by the upturned forward edge of the screed laterally to the edge of the pavement.

29. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement; a transverse squeegeeing and tamping screed pivoted or fulcrumed on said carriage substantially at its own rear edge, so that said edge may define the general grade of the pavement surface; and means for oscillating said screed vertically about its said fulcrum so as to concurrently squeegee and tamp the concrete by the concurrent advance and vibratory movement of the screed.

30. Apparatus in accordance with the preceding claim including means for adjusting the screed fulcrum up and down relative to the carriage.

31. Apparatus of the character described comprising a carriage adapted to travel along a concrete pavement; means carried thereby for removing excess concrete from the surface of the pavement; a transverse squeegeeing and tamping screed behind said removing means, pivoted or fulcrumed on the carriage substantially at its own rear edge, so that said edge may define the general grade of the pavement surface; and means for oscillating said screed vertically about its said fulcrum, so as to concurrently squeegee and tamp the concrete by the concurrent advance and vibratory movement of the screed.

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