



UDC 631.372/62.191

DOI: 10.37128/2520-6168-2023-3-10

IMPROVING THE ORGANIZATION OF CENTRALIZED RESTORATION OF AGRICULTURAL EQUIPMENT PARTS

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Effective use of machines largely depends on timely and high-quality maintenance and repair. Due to the increase in the volume of restoration of units and aggregates at specialized enterprises, an opportunity was created in the workshops of farms and collective farms to more widely apply the aggregate method of restoration and repair. Improving the organization of centralized restoration of damaged parts makes it possible to restore tens of millions hryvnas worth of parts in a year. The organization of centralized delivery of material and technical means to farms is applied using the services of equipping farms with the necessary equipment in assembled, adjusted and run-in form.

Increasing the level of concentration of repair production, deepening its specialization will allow to significantly improve the quality of repair, to bring the resource of repaired machines, tractors, combines and aggregates up to 80%.

Before repairing driven discs of clutches of tractors, cars, combines, to replace friction linings, it is necessary to carry out operations of drilling, riveting and knocking off old linings. These operations require a lot of labor and the use of additional tools, which leads to significant capital investments.

The paper proposes a device for cutting the fastenings of the friction linings of the driven clutch discs. Taking into account the conditions of agricultural enterprises, which have repair workshops, and the presence of vertical boring and milling machines, it is proposed to organize their use for the operation of removing worn friction linings.

For riveting of friction linings of driven clutch discs, the development of a hydraulic stand is proposed, which can be made from standard units in the workshops of agricultural enterprises. Using this stand will make it possible to increase labor productivity when performing this operation and reduce its time.

Key words: restoration, deformation, wear resistance, friction linings, tooling, vertical machine, milling machine.

F. 7. Fig. 2. Ref. 7.

1. Problem formulation

The growth of the equipment of agricultural production with more advanced equipment, the management of complex mechanization and the improvement of the efficiency of the use of equipment is developing, and the repair production is changing. The development of the field of restoration of worn parts is based on the close cooperation of repair production with industry and fundamental science, and the achievement of scientific and technical progress [1].

Deepening the method of group recovery technology to create unified group equipment for recovery is a promising direction of recovery technology in the organizational plan. A large number of restored machine parts are discarded due to minor wear of working surfaces, making up to one percent of the original mass of parts. In order to fulfill the tasks facing the repair production, the organization and technology of machine repair in the workshops of farms must be improved: properly plan the loading of the workshop; organize technical documentation; to provide workshops with the necessary technological equipment, tools, and materials; implement best practices in machine repair [1, 2].

2. Analysis of recent research and publications

When the car is moving, the clutch in the engaged state transmits the torque from the engine to the gearbox and protects the transmission mechanisms from the dynamic loads that arise. Thus, the load in the transmission increases with sharp braking with the engine, with a sharp engagement of the clutch, uneven



operation of the engine and a sharp decrease in the frequency of rotation of the crankshaft, collision of wheels on road irregularities [2-4].

All specified clutches, except for centrifugal clutches, are constantly switched on and off by drivers, drivers when switching gears, braking or stopping the car [2, 7].

The basis of the operation of the clutch is the friction between two disks, each of which is located on its own shaft. Friction comes from the fact that the surface of each disc has irregularities - even a very smooth surface has microscopic irregularities. The larger they are, the greater the coefficient of friction at the surface, the more difficult it is to slide on this surface [2-4].

3. The purpose of research

The purpose – Increasing reliable operation and ensuring high strength of restored parts by developing equipment for restoring and repairing clutch discs.

4. Results of the researches

Driven discs with friction linings of clutch and control clutches are made of structural sheet steel grades 40, 50 and 65G; they are hardened and tempered to a hardness of HRC 35-50. Friction pads are made of friction asbestos. The hubs of the driven discs of the clutch are made of steel grades 35, 45 and 40X and heat treated to a hardness of HRC 25-35 [2, 5].

The characteristic defects of the discs are the activation of the friction linings, the warping of the discs, the activation and loosening of the riveted joints.

Worn friction linings are replaced with new ones of the appropriate size and material. To do this, rivets are drilled, unusable linings are removed and the warping of the disks is checked, which should not exceed 0.3 - 0.5 mm. Holes are drilled in the new overlays, using the disc as a conductor; on one side of the lining, holes are countersunk to a depth of 2.5 mm. Riveting machines are used for riveting friction linings or they are riveted with a plate, beards and a hammer; it is allowed to use copper or brass tubes instead of standard rivets [2].

The heads of the rivets should go deeper into the new linings by 1-1.5 mm, and into the linings that have already worked - by at least 0.2 mm. The normal thickness of the driven discs of the clutch together with the linings should be within 8.5 - 10.5 mm, permissible - 7 mm.

The normal thickness of the linings of the friction sectors in the clutches of S-100 tractors is 5.5 mm (3.5 mm is acceptable). The unevenness of the thickness of the friction linings of the disk (or set of sectors) should not exceed 0.2 mm.

The total thickness of the driven disk of the control clutch with riveted or glued overlays is equal to: for C-100 tractors - 7.2 ± 0.35 mm, for T-74 - 9 ± 0.38 mm, for T-38 - $8 + 0.72$ (allowable thickness is 5.6 and 6.5 mm, respectively).

Instead of gluing, the lining can be glued with glues based on epoxy materials [2, 4 - 6].

The technology for gluing friction linings to disks with VS-10T film glue is that a dry adhesive film reinforced with cotton fabric is laid between the surfaces of the lining and the disk. Then the disk and the pad are compressed in a device with a specific pressure of 2-3 kg/cm² and together with the device are placed for 90 minutes in a thermal (drying) cabinet, in which the temperature is maintained at 180°C ($\pm 5^\circ\text{C}$). After cooling, the parts are removed from the clamping device and the connection is checked in accordance with the technical conditions [6].

You can also glue the pads to the disks with carbinol or bakelite glue.

If the splines in the hubs of the driven discs of the clutch clutches are extremely activated, the hubs are discarded. Driven disks, which have loosened rivets that fasten them to hubs suitable for further work, are riveted. To do this, drilled holes in the hub and disk, as well as in the oil trap, are drilled for rivets of increased sizes, or holes of normal sizes are drilled, between unsuitable holes, and standard rivets are placed.

The driven disc and the oil trap must be firmly riveted to the hub, and the linings must be securely connected to the discs. The surfaces of the linings after being glued or riveted to the discs must be perpendicular to the axis of the hub (allowable deviation ± 0.3 mm). When checking in the centers, the disc runout should not exceed 1 mm at the extreme points [2, 6-7].

Clutch couplings are disassembled on screw pressure devices or universal pneumatic type stands OPR-2157A (OPR-2827) (Fig. 1).

The recoverable disk assembly is installed on the plate 4 devices. By turning the handle of the three-way valve, compressed air is opened to the upper part of the pneumatic cylinder 3. The rod of the pneumatic cylinder moves downwards under the action of the piston. Crosspiece 2, rigidly connected to the rod, lowers

three pulls. A groove is made in the upper part of the rod, as a result of which the rod, moving in the bushings 12, is turned by 90° thanks to the screw 8, which is inserted into this groove. They compress the clutch springs with the pressure cocks 10. The cams 10 are rigidly fixed on the upper ends of the thrust with screws 9. When the air pressure in the main line is up to 0.4 MPa, the force on the rod of the pneumatic cylinder reaches 15 kN, that is, it is sufficient to compress the clutch springs.

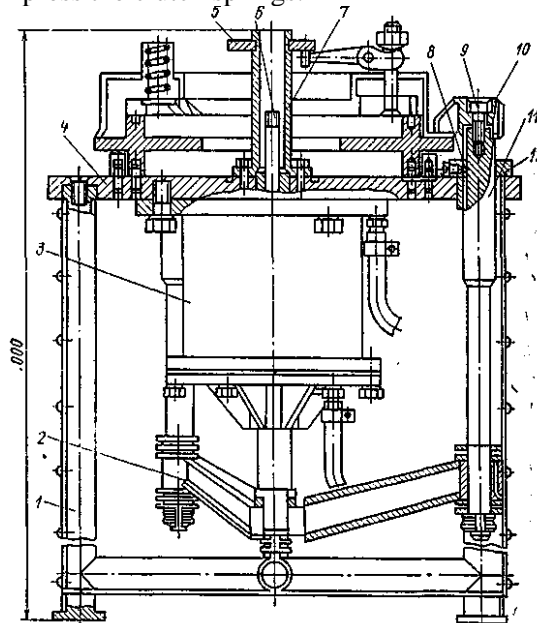


Fig. 1. Universal pneumatic stand for disassembling, assembling and adjusting tractor clutches:
1 – stand frame; 2 – cross; 3 – pneumatic cylinder; 4 – plate; 5 – adjusting washer; 6 – rod; 7 – flange sleeve; 8, 9 – pints; 10 – cam; 11 – traction; 12 – sleeve.

After compressing the springs, uncoil and unscrew the nuts of the squeeze levers and remove the crackers. By turning the handle of the air crane, the springs are released, the persistent disc is removed in the assembly with the release levers, and subsequent disassembly is carried out in a vice and on a metalworking bench [7].

Calculation of springs is carried out in accordance with DSTU 13774:2008. For class 3 springs, the stress is determined [7]:

$$\tau_3 = 0,6R_m. \quad (1)$$

The calculated stiffness of the spring is [7]:

$$C = \frac{F}{h} \quad (2)$$

The diameter of the borscht is determined by [7]:

$$d = 3 \sqrt[3]{\frac{M}{0,1 \cdot [\tau]}}, \quad (3)$$

$[\tau] = 45 \text{ МПа}$ – the diameter of the borscht is determined by the permissible load.

We check the connection of the borscht with the sleeve for crumpling and shearing [7]:

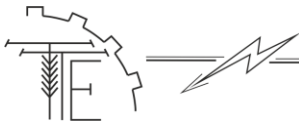
$$\sigma_{cm} = \frac{2T}{d \cdot l \cdot (h - t_1)} \leq [\sigma]_{cm}, \quad (4)$$

$$\tau_{cp} = \frac{2T}{d \cdot l \cdot e} \leq [\tau]_{cs}, \quad (5)$$

$[\sigma]_{cm} = 100 \text{ МПа}$ is the allowable crumpling stress; $[\tau]_{cs} = 0,6 \cdot [\sigma]_{cm} = 60 \text{ МПа}$ – allowable shear stress.

Calculation of bolted connection:

$$d_p = \sqrt{\frac{4 \cdot Q_{pazh}}{\pi \cdot [\sigma_p]}}, \quad (6)$$



Q_{des} – design force for the bolt, $[\sigma_p]$ – allowable breaking stress, MPa;

The allowable tensile stress is determined by:

$$[\sigma_p] = \frac{\sigma_T}{[S]}, \quad (7)$$

$[S] = 3$ – safety factor; $\sigma_T = 240$ MPa – strength limit for steel st.3.

Regardless of the given shutter speed, based on the formulas, you can make sure that at the values δ , smaller ones 0,25, all single coil springs loaded at speed V_{max} more 9,4 м/с, belong to class III.

The main malfunctions of clutches: wear of friction pads, holes for rivets, surfaces of splined grooves of the hub, surfaces of grooves and holes for guide fingers, splines and seats for shaft bearings, surfaces of cams of release levers in height, holes for the axis (fingers) of release levers, grooves of the inclusion plug; wear, burrs, cracks and distortion of friction surfaces; distortion of driven disks; wear or breakage of the threads of the leading discs; wear of the surface and damage to the groove of the veneer of the exclusion fork roller; wear of the thrust bearing; loss of elasticity of clutch pressure springs [5-7].

Weakened rivets connecting the driven disk to the hub are removed. If the wear of rivet holes in driven discs, hubs and oil deflectors exceeds the permissible, they are drilled to the repair size. Repair rivets are riveted hot.

The curvature of the discs is determined by measuring the end runout on the device OP-10585.15 [7]. End runout of the pads relative to the axis of the hub hole is allowed no more than 0.9 mm at a radius of 195 mm (SMD- 60 engine); beating at the extreme places of 0.8 mm (engines A-01, A-41) and 0.5 mm (engine D-240) [7].

Distortion of the driven discs is eliminated by straightening on the plate, on the device OP-10585.15, or by rotary straightening on the special device OD-011 [7].

For the mechanization of the processing of holes in friction linings, the OR-6456 units are used (linings 01M-2141 engine SMD-60, SMD-62), OR-6456-01 (linings 70-1601138 engines D-240, D-240I), OR-6456 - 04 (covers A-3827a of the SMD-14 engine). The installation provides simultaneous drilling and countersinking of all holes in the overlays.

The device for cutting overlays is installed on the bed of the boring machine and the basic diagram of the stand is shown in (Fig. 2).

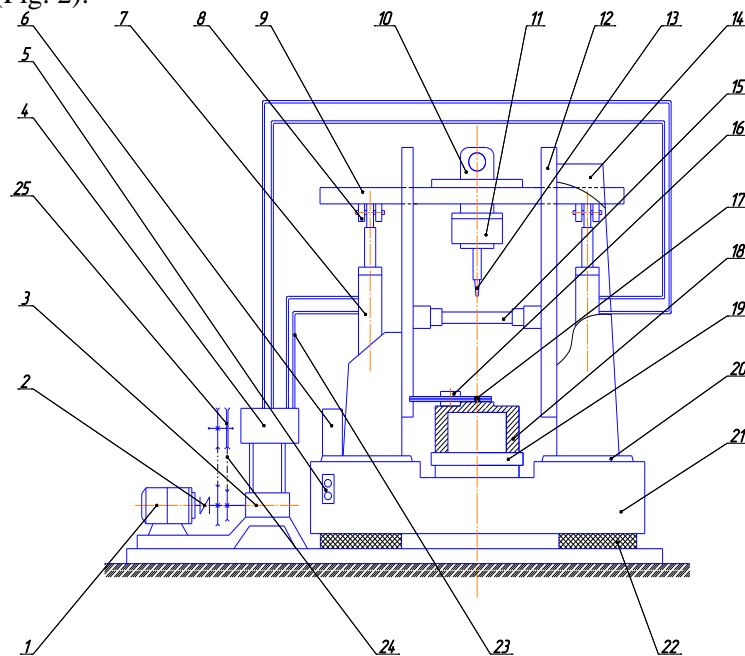


Fig. 2. Principle diagram of the stand:

1 – electric motor; 2 – coupling; 3 – hydraulic pump; 4 – distributor; 5 – starter; 6 – tank; 7 – hydraulic cylinder; 8 – rubber shock absorbers; 9 – vibrator plate; 10 – vibrator; 11 – cartridge; 12 – guide; 13 – punch; 14 rack; 15 – charging; 16 – recovery disk; 17 – rivet; 18 – base; 19 – plate; 20 – support plate; 21 – beam; 22 – shock absorber; 23 – pipeline; 24 – V-belt transmission; 25 – variator.

The driven disk of the clutch clutch, which is subject to replacement of the friction linings, is attached to the device with latches. The device is designed for the purpose of cutting fasteners of friction linings



simultaneously from two sides. To do this, we install a chain mechanism in the spindle of the boring machine, which engages the lower moving part of the device. We install a trimming cutter on the spindle, which can be used to adjust the cutting diameter. A similar cutter is installed in the lower part. When the spindle of the machine is moving, the borsht of the device is engaged. Under the action of the spring, the borsht moves from the bottom up, which allows us to cut the fastening of the friction linings from the back side. When lowering the vibrating assembly with the help of a punch, rivets are riveted on the restoration product.

Control of the V-belt double-circuit variator of the hydraulic pump drive, which allows changing the speed of movement of the rods of hydraulic cylinders, is carried out with the help of a spool valve by changing the position of the lever of one of its working sections.

Thus, fasteners are cut from two sides, and this allows you to save time for drilling and riveting of overlays. The device can be used in central repair workshops of agricultural farms where boring and vertical milling machines are available.

5. Conclusions

Before repairing driven discs of clutches of tractors, cars, combines, to replace friction linings, it is necessary to first carry out such operations as drilling, riveting and knocking off old linings. These operations require a lot of labor and the use of additional tools, which leads to significant capital investments.

To solve this problem, a device is proposed for cutting fasteners of friction linings of driven clutch disks. Taking into account the conditions of agricultural enterprises that have repair workshops and the presence of vertical boring and milling machines, it is suggested to use them for the operation of removing worn friction linings.

The development of a hydraulic stand, which can be made from standard units in the workshops of agricultural enterprises, is proposed for riveting the friction linings of the driven clutch discs. Using this stand will make it possible to increase labor productivity when performing this operation and reduce its time. These studies were carried out within the framework of the scientific topic "Investigation of ways to optimize the performance of the technological process for the manufacture of fatty acids esters for diesel biofuel" (State registration number: 0122U002187 dated 30.03.2022.)

References

- [1] Trukhanska, O. (2022). Innovative approaches and methods of increasing the technical level machines and units. *Engineering, Energy, Transport AIC*, 3 (118), 15–18. [in English].
- [2] Sidashenko, O.I. (2014). *Remont mashyn ta obladnannia: pidruchnyk [Repair of machines and equipment: a textbook]*. K. Ahroosvita. [in Ukrainian].
- [3] Baranovsky, V., Truhanska, O., Pankiv, M., Bandura, V. (2020). Research of a contact impact of a root crop with a screw auger. *Research in Agricultural Engineering*, 66, 33–42. [in English].
- [4] Trukhanska, O.O. (2018). Pidvyshchennia yakosti remontu i tekhnichnoho obsluhovuvannia silskohospodarskoi tekhniki. *Engineering, Energy, Transport AIC*, 3 (102), 52–62. [in Ukrainian].
- [5] Trukhanska, O. (2020). Technological methods of increasing wear resistance and durability of details. *Engineering, Energy, Transport AIC*, 4 (111), 109–115. [in English].
- [6] Truhanska, O.O. (2020). Perspektivni napryamki tekhnologii vidnovlennya detalej mashin. *Vibrations in engineering and technology*, 3 (98), 104–110. [in Ukrainian]
- [7] Shvets, L.V., Paladiichuk, Yu.B., Trukhanska, O.O. (2019.) *Tekhnichniy servis v APK. Tom I [Technical service in agriculture. Volume 1]*. Vinnytsia: VNAU. [in Ukrainian].

Список використаних джерел

1. Trukhanska O. Innovative approaches and methods of increasing the technical level machines and units. *Техніка, енергетика, транспорт АПК*. 2022. № 3 (118). С. 15–18.
2. Сідашенко О. І. Ремонт машин та обладнання : підручник. К. Агроосвіта, 2014. 665 с.
3. Baranovsky V., Truhanska O., Pankiv M., Bandura V. Research of a contact impact of a root crop with a screw auger. *Research in Agricultural Engineering*. 2020. Vol. 66. P. 33–42.
4. Труханська О. О. Підвищення якості ремонту і технічного обслуговування сільськогосподарської техніки. *Техніка, енергетика, транспорт АПК*. 2018. № 3 (102). С. 52–62.
5. Trukhanska O. Technological methods of increasing wear resistance and durability of details. *Техніка, енергетика, транспорт АПК*. 2020. № 4 (111). С. 109–115.



6. Труханська О.О. Перспективні напрямки технології відновлення деталей машин. *Вібрації в техніці та технологіях*. 2020. № 3 (98). С. 104–110.
7. Швець Л. В., Паладійчук Ю. Б., Труханська О. О. Технічний сервіс в АПК. Том I. : навч. посіб. ВНАУ : Вінниця, 2019. 647с.

УДОСКОНАЛЕННЯ ОРГАНІЗАЦІЇ ЦЕНТРАЛІЗОВАНОГО ВІДНОВЛЕННЯ СПРАЦЬОВАНИХ ДЕТАЛЕЙ СІЛЬСЬКОГОСПОДАРСЬКОЇ ТЕХНІКИ

Ефективне використання машин великою мірою залежить від своєчасного і якісного проведення технічного обслуговування і ремонту. Впровадження і організація технологій централізованого відновлення деталей, а також постійний вплив сучасного удосконалення та ускладнення сільськогосподарської техніки є природним результатом її розвитку.

Удосконалення і розширення потужностей підприємств для відновлення і ремонту нових марок тракторів, комбайнів, автомобілів, обладнання тваринницьких ферм є актуальним. За рахунок збільшення обсягу відновлення вузлів і агрегатів на спеціалізованих підприємствах створилась можливість у майстернях фермерських та колективних господарств ширше застосовувати агрегатний метод ремонту. Централізоване відновлення спрацьованих деталей дає можливість за рік відновлювати деталей на десятки мільйонів гривень. Підвищення рівня концентрації ремонтного виробництва, поглиблення його спеціалізації дозволили значно поліпшити якість ремонту, довести ресурс відремонтованих тракторів до 80% ресурсу нових тракторів.

В роботі запропоновано пристрій для зрізування кріплень фрикційних накладок ведених дисків зчеплення. Враховуючи умови сільськогосподарських підприємств, у яких є ремонтні майстерні, та наявність вертикальних розточних та фрезерних станків у господарстві, пропонується організація їх використання для здійснення операції видалення зношених фрикційних накладок при використанні гідравлічного станку, який можна виготовити із стандартних одиниць в умовах ремонтної майстерні.

Ключові слова: відновлення, деформація, зносостійкість, фрикційні накладки, оснастка, вертикальний станок, фрезерний станок.

Ф. 7. Рис. 2. Літ. 7.

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